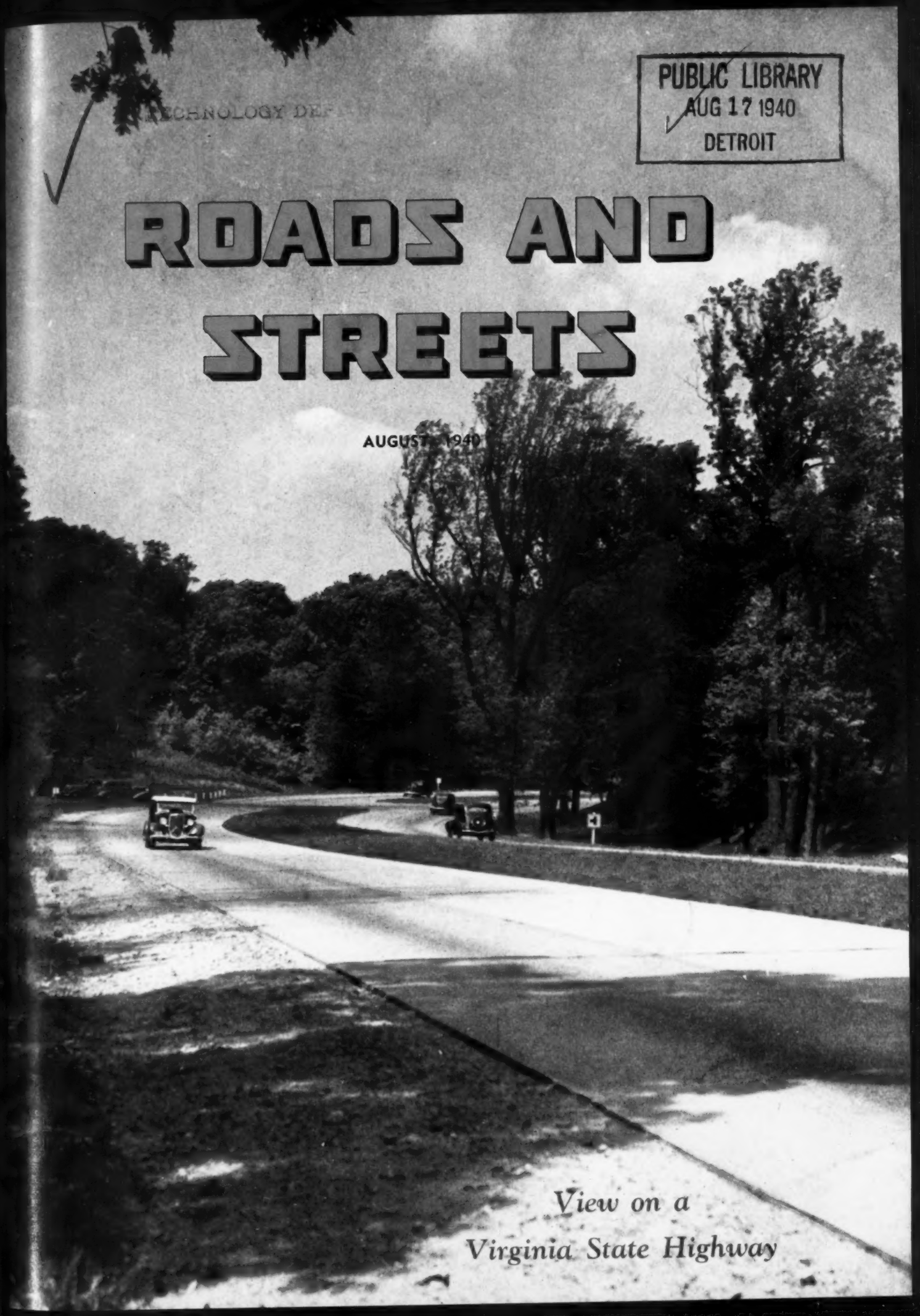
ROADS AND STREETS

AUGUST 1940



View on a Virginia State Highway

Adams ANNOUNCES 2 NEW MOTOR GRADERS WITH *Important* IMPROVEMENTS

Positive, dependable mechanical controls quickly and accurately adjust the blade to any desired working position—for ditch cuts, high bank cuts, flat backslopes and wide reaches outside the grader for finishing shoulders. Blade lift linkage easily adjustable for extreme cuts but one standard setting of links permits doing 90% of all average "bank to bank" work, permitting all adjustments to be made quickly and easily from operator's cab.

● Adams Heavy-Duty Motor Graders Nos. 50 and 51, several thousand of which are giving satisfaction throughout the world, are now superseded by two new models with the following important improvements which give you still more value for your motor grader dollar:

INCREASED POWER (DIESEL): The No. 511 is powered by new 66½ h.p. Diesel engine; No. 501 has 66½ h.p. gasoline engine. Plenty of live power for all kinds of work.

NEW STARTING ARRANGEMENT (DIESEL): Engine starts easily on gasoline and is converted into a full Diesel engine simply by throwing a lever in the operator's cab.

NEW CAB: Features operator's seat adjustable backward and forward for "stand up" and "sit down" operation. Seat and back rest also adjustable for height.

NEW BRAKES: New, self-energizing Bendix hydraulic brakes provide quicker and more positive brake action.

NEW STEERING GEAR: Provides fast and easier steering.

ADJUSTABLE LIFT LINKS: Permit easier and wider range of adjustments. One standard setting of links, however, permits doing 90% of all average work without any changes.

Don't buy any motor grader until you investigate these new machines. Write or call your local Adams representative today or write for catalogs to

J. D. ADAMS COMPANY, INDIANAPOLIS, INDIANA

Branches, Representatives and Distributors throughout the United States

No. 511 —66½ H.P. *Diesel* ENGINE

No. 501 —66½ H.P. *Gasoline* ENGINE

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ROADS and STREETS

With which have been merged GOOD ROADS and ENGINEERING & CONTRACTING

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THIS MAGAZINE IS DEVOTED TO
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ROADS and STREETS

Vol. 83, No. 8 August, 1940

A GILLETTE PUBLICATION

ESTABLISHED 1906

STABILIZED CONSTRUCTION ON NATCHEZ TRACE

Paving Mixers and Side Forms Facilitate Operations on 12-Mile Section Near Natches, Mississippi

RECONSTRUCTION of the Natchez Trace into a parkway—extending the approximate 500 miles from Nashville, Tenn., to Natchez, Miss., was adopted as a permanent project of the National Park Service in 1938. Under supervision of the Public Roads Administration, several sections of the road were placed under construction last year in the three states traversed by the route, and the 1940 program got underway early this spring.

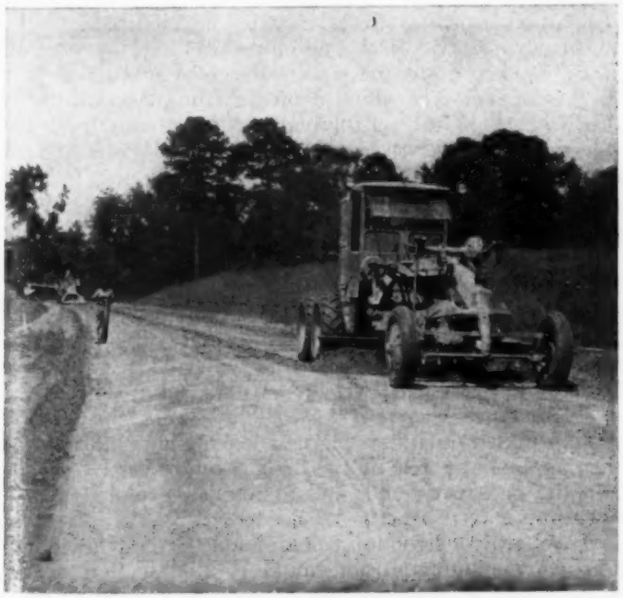
Since the parkway is particularly designed for pleasure and sightseeing use, there will be no roadside advertising signs, hotdog stands or any of the other ugly structures that mar so many of our present day road-

Construction View at One of the Cuts

sides. To keep the highway, itself, in tune with the unspoiled country through which it passes, the authorities are adopting, as far as possible, types of road surfacing that are substantial and at the same time harmonize with the natural surroundings.

The first part of the new parkway to be completed late in 1939 was a 12-mile calcium chloride stabilized section just outside the southern terminus at Natchez. For surfacing on this section, a stabilized soil-aggregate mixture was used, designed to meet the following Public Roads Administration specifications, as determined for this particular project:

Gradation of Material	*Per Cent*
Passing 1½-in. sieve	100
Passing 1-in. sieve	70-100
Passing ¾-in. sieve	60-90
Passing ⅜-in. sieve	50-80
Passing No. 4 sieve	35-65
Passing No. 10 sieve	25-50
Passing No. 40 sieve	15-30
Passing No. 200 sieve	5-15



Preparing Subgrade to Receive Base Course of Stabilized Material

Mixing and Placing Stabilized Materials. Truck in Background Is Hauling Material from Pit to Mixer, While Patrol Grader Is Shaping Up Base Course

The specifications further stipulated that, after mixing of the gravel and binder-soil, the fraction of the mixture passing a No. 40 sieve must have a liquid limit not exceeding 25 and a plasticity index not exceeding 6; the fraction passing a No. 200 sieve must not exceed one-half of the fraction passing the No. 40 sieve.

Suitable local aggregate and soil materials were located close to the project and were used throughout. The base course mixture consisted of gravel from one pit combined with the correct percentage of binder-soil from another source. For the surface course, however, a gravel deposit was found from which a proper combination of gravel and pit overburden produced a mixture that met gradation requirements.

The stabilized mat was constructed in two layers, each of 3-in. compacted depth, to produce a finished thickness of 6 in. After the required grading had been accomplished, wood forms of 6 in. height were placed 22 ft. apart along the edges of the roadway to facilitate placement of the stabilizing materials.

Gravel and pit overburden, after excavation from the pit, were proportioned and partially mixed by means of a drag-line bucket, before loading into trucks. Arrived on the road, the material was dumped directly into the skip of a concrete paving mixer, elevated and poured into the mixing drum. The discharge chute was kept open at all times, causing a continuous discharge of mixture into a 10-ft. spreader box which deposited the material on the roadway. A motor patrol blader spread and level the material to the 22 ft. width between the forms and an uncompacted depth of 4 in.

Gravel and Binder-Soil Were Partially Mixed by Dragline Bucket before Trucking to Road

Shaping Up Base Course Prior to Application of Surface Layer of Stabilized Mix

Compaction of the first, or base, course to 3 in. depth was supplied by the continual traffic of trucks hauling materials for the surface course.

The same mixing and spreading procedure was followed for the top course and, after the surface had been shaped up and properly crowned, initial compaction was secured by rolling with dual-wheeled trucks. A 3-wheel, 7-ton roller was used for final rolling, and, when sufficient moisture was not provided by rains, the surface was sprinkled during rolling. Flake calcium chloride was then applied at a rate of 1½ lb. per square yard, to maintain the moisture bond, and maintenance plans call for subsequent retreatments as needed.

The 1940 construction schedule on the Natchez Trace Parkway includes an additional 10-mile section of calcium chloride stabilized surfacing in Wayne County, Tennessee.

EQUIPMENT MAINTENANCE IN JACKSON COUNTY, MISSOURI

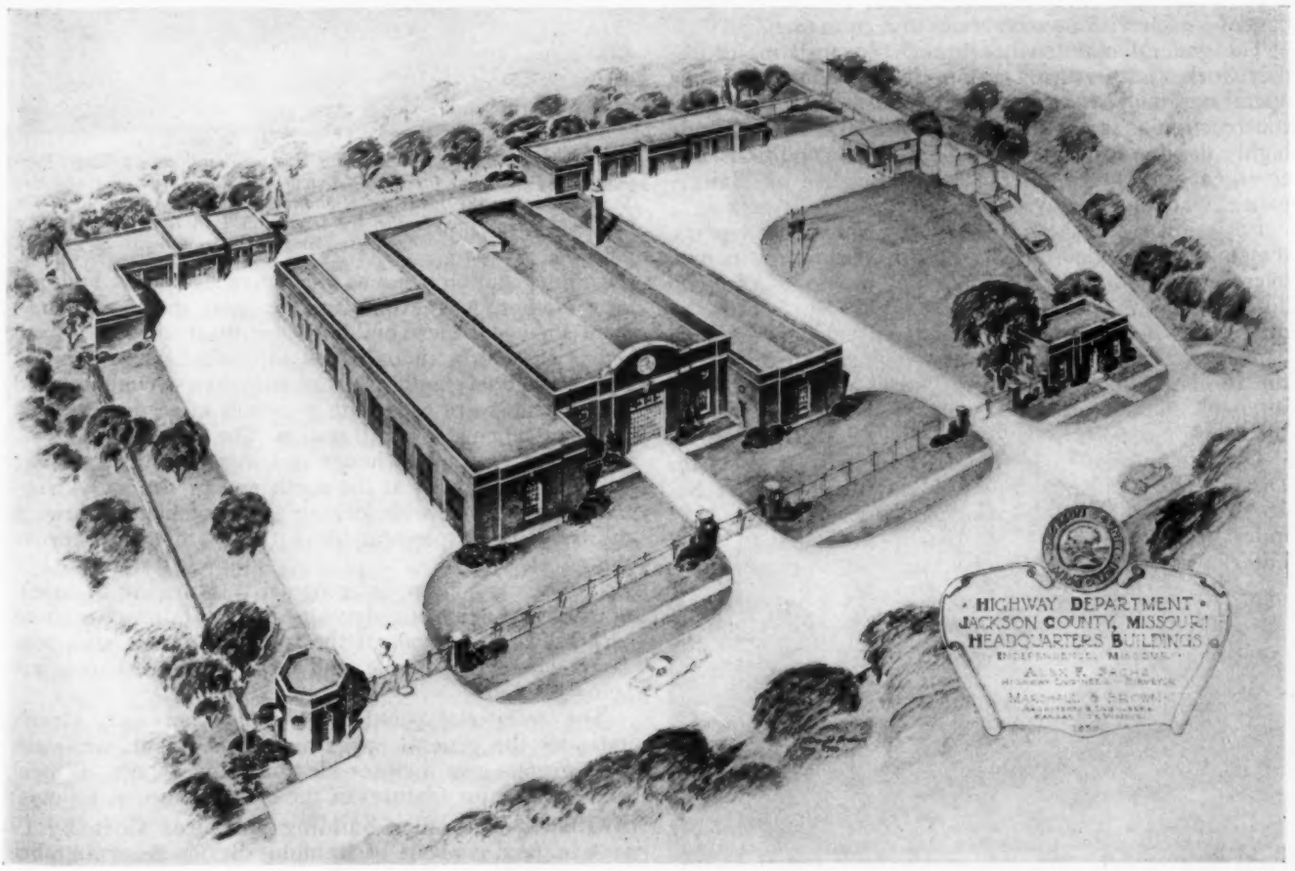
The New Plant, Its Personnel, Equipment Cared for, the Record System, and Certain Data on Gasoline and Oil Consumption

By JOHN C. BLACK
Field Editor, Roads and Streets

THE Jackson County Highway Department garage and shops at Independence; the equipment housed and repaired therein; the record system with which materials and labor are accounted for as accurately and efficiently as in a first-class commercial garage; the garage and shop personnel, its organization and its relation to the maintenance forces are interesting examples of advanced practice in the administration of equipment and maintenance departments.

Of interest to contractors as well as public officers are the records for individual equipment units. Started in 1938 as a part of the general garage accounting system, they are giving valuable information on the consumption of gasoline and lubricants. As they mature they will afford a basis for the close estimating of equipment operation, upkeep and depreciation, and the determination of the proper time to discard an old unit and replace it with a new or different one.

Jackson County, with a population of 470,454 in the 1930 census, and an area of 607.57 square miles, at



Architects' Sketch of the Jackson County, Missouri, Highway Department Headquarters. Yard and Buildings Face Easterly

Main Building as Seen from an Opposite Hill. The Circular Ornament Over the Doorway Is the Seal of Jackson County.

present maintains a total of 1,285.92 miles of highways, classified by surfaces as follows:

	Miles
Concrete	199.98
Retread	51.49
Macadam	101.34
Asphalt	17.02
Armor Coat	13.41
Crushed Rock	50.20
Oiled Earth	852.48
	2,285.92

State highways, and roads and streets within municipalities (including Kansas City) are not parts of the County system. No point within the county is more than two miles from a hard-surfaced road.

The Highway Department operates under its own special tax levy.

General and District Maintenance

Road Maintenance operations are divided into two main classes for practical administration and performance — "General Maintenance" and "District Maintenance"—each with its own crews and equipment.

The general maintenance branch does all major repair work, and performs certain diversified maintenance operations on paved highways. It also does such new construction as is not contracted. This branch was made highly flexible to meet varying needs or conditions and emergencies. Its head is the Superintendent of Maintenance, who reports directly to the Chief Engineer.

For regular patrol, and minor and emergency repairs, the county is divided into 16 districts, each with its own overseer, which gives this class of work its common designation as "Overseer Maintenance." But because of differences in the problems and requirements of suburban districts and the less densely populated rural areas, the 16 districts are grouped in two Divisions, each with its own Superintendent, to whom the Overseers within the division report.

District mileage varies from a minimum of 47.98 for District No. 4 to a maximum of 154.49 for District No. 16. The lowest class of surface, oiled earth, totals 26.91 miles in District No. 4, and has a maximum of 78.71 miles in District No. 8. County Highway Engineer, Alex F. Sachs considers that with existing pavements and traffic conditions, each present district includes the maximum mileage which may be satisfactorily cared for by one overseer.

A General View of the Paint Shop and Warehouse. Platform Near the Left Is for Delivery of Materials

Each maintenance district has its own operating budget, against which all expenses are charged. A monthly budget report keeps the overseer informed of his district's exact financial status. Below is a copy of such a report:

STATUS OF DISTRICT BUDGET
District No. 8

Item	Amount
1. Allotment for 1939	$4,101.50
2. Expended to 12-1-1939	3.771.60
3. Reserve—Overseers' Salary	125.00
4. Reserve—Regular Men	166.40
5. Total Deductions	4,063.00
6. Balance Available	38.50
7. Unexpended—1938 Budget	7.92
8. Net Balance 12-1-1939	46.42

Yards, Buildings and Garage Equipment

The Highway Department's Yard at Independence is a lot 294.0 ft. deep with a frontage of 361.2 ft. on Chrysler Ave., a rear width of 454.7 ft. and an irregular fourth side—area approximately 2¾ acres. Near its center stands the main garage and shop building. The maintenance office is located on one front corner and

The Maintenance Office Building. Large Windows at Rear Provide Good Lighting for Office and Other Rooms. Tank Cars Are Switched in on the Railroad Embankment at Right for Transfer of Oil and Gasoline to the Bulk Station Visible Back of Office Building

the filling station with its attractive octagonal building on the other. At the rear are the paint shop and equipment shed. All these buildings are finished with a local red brick which, though now somewhat garish, should tone attractively with age. Colonial doors, windows and minor details are used with excellent effect in the main building, office and filling station. The bulk oil and gasoline tanks, with pump house and sheet metal oil storage building are located at the north end of the lot. A substantial wire fence with locking gates completely encloses the tract. Brick piers at the entrances greatly improve the effect.

Landscaping, also, is recognized as worthy of attention. Lawns are being developed over appropriate areas especially at the front of the tract—old trees have been saved wherever possible, and new shrubs and trees are being planted.

The architects' perspective, shown herewith, clearly indicates the general appearance and layout, while the photographs give a closer idea of many details. Dimensions and major features of the buildings are as follows:

Office.—The office building measures 45 ft. by 19 ft. 4 in., and is about 14 ft. high. Beside the main office room and the necessary toilets, locker rooms, etc., it contains a small laboratory and a private office. Interior

Interior of Maintenance Office, Showing Desks and Switchboard. Large County Map Is on Another Wall

walls are of yellow-brown glazed tile. Deadened ceilings prevent disturbing noise. Desks are metal; the floor is covered with battleship linoleum; and the whole appearance is that of a room designed appropriately to purpose.

Filling Station.—The octagonal station building measures 6 ft. 7½ in. on each side, and is 14 ft. 4½ in. high from ground to top of parapet wall. The interior is of tile similar to that used in the office. One gasoline pump stands in front, outside the fence, and another a little way inside the gates, where trucks may stop on either side of it. Each pump is supplied from a 500-gallon underground tank. These tanks, in turn, receives their supplies by truck from the bulk station at the other end of the yard. During the busy season one delivery per day is required. It is made on the early morning before the tank truck starts on its round of service about the county.

Air for tires and water for radiators are available at the gas pump platform inside the yard. Air, incidentally, is distributed from a compressor and reservoir in the machine shop to all necessary points about the grounds or buildings.

Main Building. — Dominating the establishment architecturally is the building containing main storage garage, service department, stock rooms and repair shops. Across the front it measures 149 ft. 11½ in. and its overall depth is 168 ft. 7½ in. The central portion, however, 72 ft. 5½ in. wide, is recessed 18 ft. at the front, leaving a depth of 150 ft. 7½ in.

The garage, located at the front-center, has a floor area of 6,500 sq. ft. Trucks and miscellaneous equipment are kept here when not in use.

A portion of the south wing of the building is utilized for the storage of trucks of the maintenance crews. Twelve trucks or other units can be cared for here at one time.

The service department is located in the north wing, where inspection and grease pits are available. These, and all other pits in the building, are flood-lighted. All oiling, lubrication, tire changing and battery charging are done here. Adjoining the lubricating room is the thoroughly equipped wash room.

A stock room for maintenance materials, tools and heavy repair parts is located directly behind the maintenance truck storage room. Automotive parts and miscellaneous small items are kept in an adjoining interior room.

The southwest corner of the building is occupied by the tractor and blacksmith shop, equipped with a 10-ton traveling crane, where tractors and heavy equipment can be taken down and overhauled. Floor area 1,380 sq. ft. Adjoining it, in the rear center of the building, is the shop for general heavy overhauling of trucks and miscellaneous equipment. It measures approximately 38 by 72 ft. and is provided with two repair pits.

A spacious machine shop—floor area 1,330 sq. ft.—occupies the northwest corner, and the boiler room occupies the space between it and the service department. The boiler is for heating only. Steam is piped from it to the maintenance office, filling station, paint shop and bulk oil station.

The Superintendent of Equipment has a neat and comfortable office located at the front of the building and finished like the maintenance office.

Excellently equipped shower, locker and dressing rooms are located above the stock room.

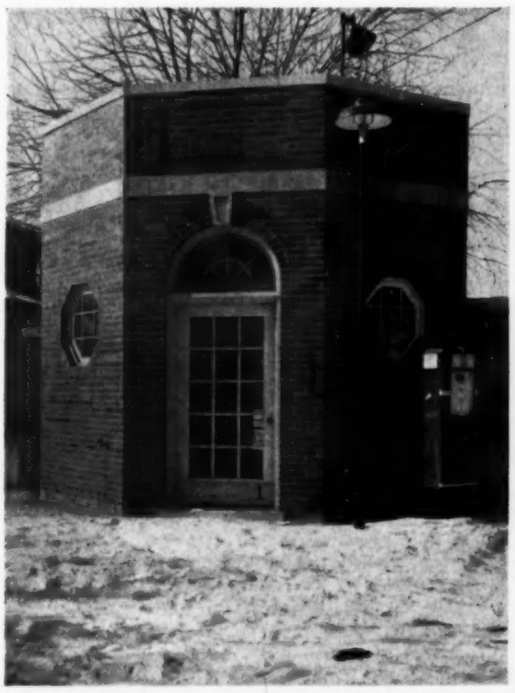
The front height of this main building, from ground to parapet coping is 21 ft. 9 in. for the north and south wings, and 26 ft. 7 in. for the center part. The curved ornamental section rises higher.

The segregation of various garage activities, as indicated in this sketchy description of the building, was planned to improve efficiency; which purpose it seems to have accomplished well.

Paint Shop and Equipment Shed.—It is regrettable that these two buildings were built entirely without ornament, for in spite of their location at the rear of the lot, they are conspicuous from many angles. Granting that things utilitarian should be simple, simplicity here has been carried to extreme. The plain horizontal band of light stone called for in the original architectural drawings would have done much to relieve the cheerless character of these structures.

The first of these two buildings—an L-shaped structure of 3,700 sq. ft. area—provides space for the paint, carpenter and sign shops, together with lumber and cement storage.

The equipment storage shed is 136 ft. 8 in. long by 30 ft. deep, in addition to which it has three front bays—two projecting 5 ft. and one 9 ft. Here tractors and certain other units are housed for the winter and other times when necessary.



Filling Station Building from the Street. A Brick Gate Pier Is Partly Visible on Each Side. The Gate at Left Is for Pedestrians Only

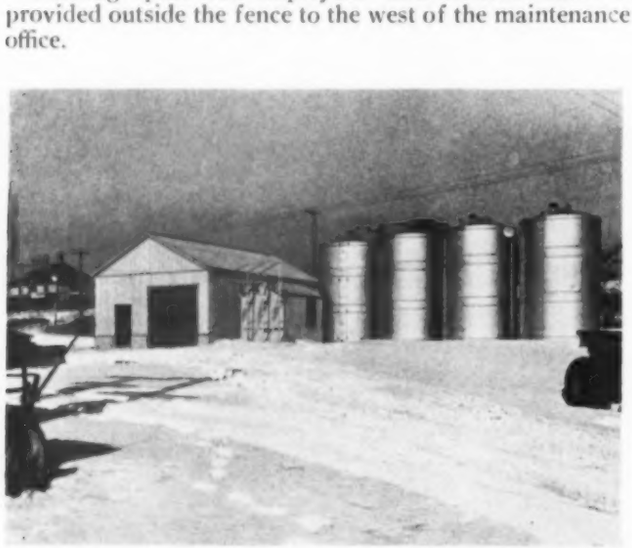
Interior of Paint Shop. Note Overhead Lights and Heaters and Ceiling Ventilator with Fan

Gas and Oil Storage.—Important in this county installation are the oil and gasoline storage facilities, commonly known as the "bulk plant." Four 12,000-gallon tanks provide storage for diesel oil, fuel oil, regular gasoline and high test gasoline. They are filled from railway tank cars spotted on the siding a short distance outside the yard. Pumps for handling these materials are housed in a small sheet metal building.

Lubricating oils are delivered from the railroad at this point in drums, and are stored in a metal building which also is a garage for the County's gasoline tank truck. Oil, incidentally, is no more expensive in drums than it would be in bulk, and is much more convenient.

Yard Storage and Parking.—The large yard at Independence provides ample space for storing all equipment which does not require housing. At the time of my visit, in mid-April, several V-plows, graders, rippers, planers and other types of units were standing in the space between the office and the bulk oil plant; while between the paint shop and the equipment shed a row of straight blade plows was waiting to be overhauled at any opportune time before next winter.

Parking space for employees' and visitors' autos is provided outside the fence to the west of the maintenance office.



The "Bulk Plant" Has Four Tanks Holding 12,000 Gallons Each —Fuel Oil, Diesel Oil, Regular Gas and High Test Gas. The Larger of the Two Metal Buildings Is the Garage for Gasoline Truck and the Storehouse for Lubricants. The Smaller Buildings Is the Oil and Gasoline Pump House.

History and Cost of Recent Improvements

The development at Independence looks brand new although the County Highway Department has used the site for many years. About all that remains of the earlier construction is a portion of the main building, and this has been so treated that it gives no exterior, and very little interior, evidence of its origin.

The improvements were carried out as a P. W. A. project through the fore part of last year, and were in full service by December. The total cost of the new work was $125,281.97, of which the Federal Government contributed $56,224.00.

Jackson County's Equipment Inventory

Construction and maintenance equipment serviced at the Independence plant, and stored there when not in use, is given in the following list as of December 31, 1939.

Passenger Cars
- 15 Light passenger autos (coupes, coaches, sedans)
- 1 Station wagon
- 4 Light pickups

Trucks and Trailers
- 28 1½-ton dump trucks
- 1 2-ton dump truck
- 1 2½-ton dump truck
- 2 2-Yard dump trucks
- 4 4-yard dump trucks
- 3 Flat bed trucks
- 1 Panel truck
- 1 Tank truck
- 1 22-ton trailer

Tractors
- 2 30 H. P. gasoline crawlers
- 1 40 H. P. gasoline crawler
- 1 60 H. P. gasoline crawler
- 1 70 H. P. gasoline crawler
- 10 35 H. P. diesel crawlers
- 2 45 H. P. diesel crawlers
- 1 70 H. P. diesel crawler
- 1 90 H. P. diesel crawler

Rollers
- 1 2-wheel 5-ton
- 1 3-wheel 6-ton
- 1 3-wheel 7-10 ton
- 1 Sheeps' foot tamper

Graders (Pull-type)
- 8 7-ft. blade graders
- 5 8-ft. blade graders
- 2 9-ft. blade graders
- 2 10-ft. blade graders (rubbertired, hydraulic)
- 2 12-ft. blade graders (rubbertired, hydraulic)

Concrete Mixers
- 1½-sack mixer
- 2 2-sack mixers
- 1 Mixer heater

Road Machinery
- 4 Disc machines
- 4 Road planes

Pumps and Tank
- 1 2½-in. gasoline pump
- 1 3-in. gasoline pump
- 1 400-gallon tank

Mud Jack
- 1 Mud jack

Snow Plows
- 2 8-ft. blade plows
- 19 9-ft. blade plows
- 1 No. 40-X-4 blade plow
- 2 No. 40-B-1 blade plows
- 3 V-type plows

Pneumatic Equipment
- 3 Compressors

Rotary Scrapers
- 6 Scrapers

Plows
- 2 Moldboard plows
- 1 Rooter plow

Mowing Machines
- 8 Tow mowers
- 3 Gasoline power mowers

Miscellaneous Equipment
- 1 Spike tooth scarifier
- 1 Ripper
- 1 Tiller
- 2 Underbody maintainers
- 1 Gasoline core drill (not mounted)
- 1 Self-feeding loader (gas-powered)
- 2 Truck shovels
- 1 Pile driver
- 2 Draglines
- 1 ⅝-yard crawler shovel
- 2 Crane booms
- 1 ½-yard clamshell bucket
- 1 12-yard scraper
- 1 Bulldozer
- 1 Trailbuilder
- 1 Rotary broom for road maintainer

Maintainers
- 20 2-wheel berm maintainers
- 3 Motor graedrs

Asphalt Equipment
- 1 400-gallon distributor
- 2 Chip spreaders

Road Drags
- 16 Multiple-blade drags

Rock Wagons
- 13 Trailer-type, side-dump wagons

Tool Houses
- 4 Skid-mounted tool houses
- 9 Trailer-mounted tool houses

Portable Rock Crusher
- 1 Trailer-mounted crusher, with 16x16 roll, 9x40 jaw and elevator
  Portable bins, screens, motor, etc.

Each piece of equipment in this list is identified by a number, which is used in all records and reports of it. These numbers are made characteristic for each class of units, all passenger autos, for example, carrying the introductory letter "C," followed by a number. All truck numbers carry the letter "T"; all tractors have the num-

ber "1" followed by a dash and the number for the unit, ("1–8," for example, for the oldest of the Caterpillar diesel 40's). Similarly, all roller numbers begin with "2," graders with "4" or "5," and so on.

The passenger autos were purchased in 1937, 1938 and 1939 in about equal numbers. Six of the trucks were purchased in 1939, twenty in 1938, and the remainder in earlier years, one dating from 1928. The 30, 40 and 60 H. P. gasoline tractors are old, and near the end of their useful lives. The other tractors are comparatively new and in good condition. Two were purchased in 1939. A considerable part of the remaining equipment, including all the road drags, rock wagons and trailer-mounted tool houses, was new last year.

Truck Maintenance Schedule.—Each week day, excepting Saturdays, one of the 16 district maintenance trucks is brought to the garage for general overhauling, and a "loaner" is sent out in its place. On the principle of "a stitch in time" this system prolongs truck life, and presumably also keeps maintenance costs lower than they would be if repairs were allowed to accumulate.

Shop Equipment

Major items in the machine shop include one each of the following:

Lathe, 18 in. (Champion)
Lathe, 6 in. (Star)
Shaper, 18 in. (Steptoe)
Power Hacksaw (Kwik-kut)
Drill Press (Mechanics Mach. Co.)
Highspeed Drill Press (Atlas)
Disc Rolling Machine
Electric Grinder (Valley)
Bench Grinder, 8 in. (Black & Decker)
Valve Refacer (Black & Decker)
Air Compressor, 100 lbs.-135 C.F.M. (Sullivan)
1½-tone Hoist (Yale)
Motor Lift (Manley)
Motor Stand (Manley)
Acetylene Welding Outfit
42-in. Arbor Press, 60 tons (Weaver)
Arbor Press No. 5 (Greenero)
Over-head Traveling Crane, 10-ton (Wright)
Trip Hammer, 50 lb. (Little Giant)
Blacksmith's Forge

A considerable part of this equipment operates from a line shaft driven by a 10 H. P. General Electric motor.

Organization and Personnel

Jackson County has the distinction of two courthouses—one in Independence—the other in Kansas City. Headquarters of the Highway Engineer and other general officers are in the Kansas City courthouse.

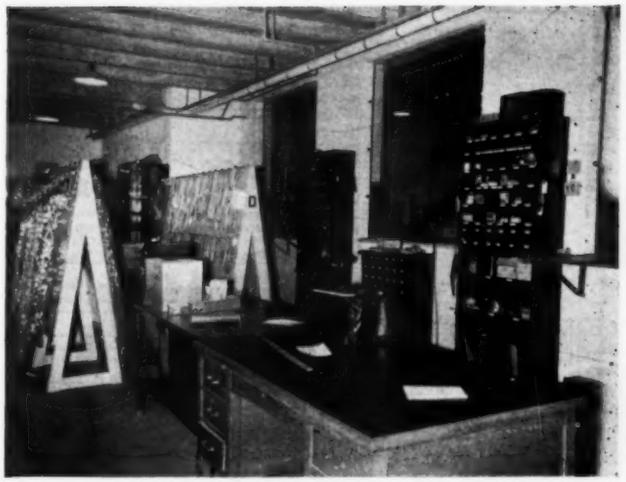
The maintenance superintendent, maintenance record clerk, equipment record clerk (listed with yard and shop staff below) and telephone operator are housed in the maintenance office building on the corner of the headquarters tract at Independence.

Yard and Shop.—The regular yard and shop staff during the season of active road work is as given below. In the off-season it is somewhat reduced.

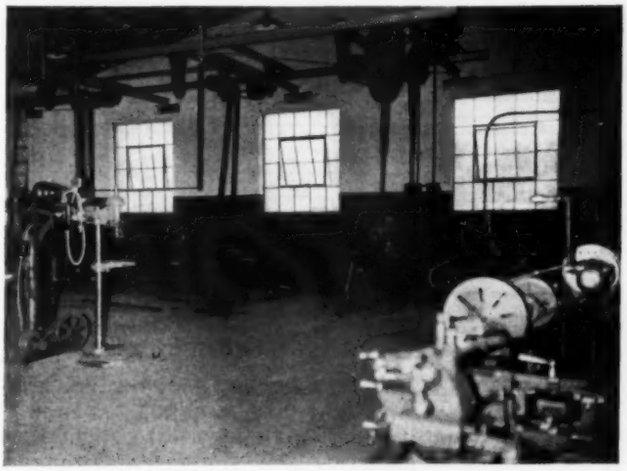
1 Superintendent of Equipment
1 Shop Foreman
1 Storekeeper
3 Storekeeper Helpers
1 Record Clerk (1 storekeeper helper also works chiefly on records)
1 Filling Station Attendant
6 Mechanics
3 Mechanics' Helpers
1 Machinist
1 Blacksmith
1 Minor Emergency Service and Repair Man ("hot shot")
1 Greasing, Battery and Tire Man
1 Utility Man on Plant Heating, Power, etc.
1 Painter and Sign Man
2 Painter Helpers
3 Watchmen (8 hour shift, each)
1 Messenger and Pickup Boy.

In the foregoing list, the mechanics, mechanics' helpers, machinist, blacksmith, painter and utility men are all union labor.

It is interesting to note that the telephone operator is a former Highway Department tractor operator whose eyesight was so injured in an automobile accident that he was unable to continue his old work. On the switchboard he has no difficulty, and his familiarity with maintenance operations and equipment adds much to his efficiency and general usefulness.



Interior of Parts Stock Room



A View in the Machine Shop

The 12-Yard Scraper in General Repair Shop

HIGHWAY DEPARTMENT
JACKSON COUNTY MISSOURI

RECONDITIONING ORDER — CARS AND TRUCKS

MAKE | TYPE | YEAR | EQUIPMENT NO.
MILEAGE | DATE RECEIVED | DATE RELEASED

ITEMS CHECKED IN THIS COLUMN NEED REPAIRS ACCORDING TO INSPECTION

INSTRUCTIONS FOR ACTUAL RECONDITIONING
CHANGE OIL | FLUSH & REFILL TRANS. | DIFF'L
LUBRICATE | WASH CAR | POLISH

- MOTOR
- TRANSMISSION
- STARTER
- GENERATOR
- IGNITION
- BATTERY
- BRAKES - FOOT ☐
- BRAKES - HAND ☐
- STEERING
- RADIATOR
- FRONT AXLE
- REAR AXLE
- CLUTCH
- SPRINGS
- BODY
- SHOCK ABSORBERS
- LIGHTS
- PAINT
- UPHOLSTERY
- GLASS
- TOP & CURTAINS
- FENDERS & RUNNING BOARDS
- TIRES
- WHEELS
- WASH
- POLISH
- TUNE UP
- INSPECTION

ENTERED BY | THE ABOVE WORK AUTHORIZED BY | ORDER
DATE | _____ | Nº 4476

Work Orders for Cars and Trucks (Triplicate 6x9 in.)

General Maintenance.—The general maintenance division, operating from the Independence station, employs from 20 to 80 men—machine operators, pavement finishers and laborers—according to its highly variable needs.

Maintenance Districts.—Each of the 16 maintenance districts has regularly one overseer, one truck driver and one helper. Additional help is employed as needed, and at the height of spring maintenance operations averages about 8 men per district. The overseers remain normally in their own districts, and report at general headquarters only as special circumstances may require.

Each overseer is supplied regularly with one dump truck, one road drag, one two-wheel blade, and necessary small tools. In winter he also has a single blade snow plow which he mounts on truck as needed.

Equipment Repair Procedure

With the completion of the new buildings and the provision of adequate shop equipment and other facilities, the office system for recording equipment maintenance was correspondingly improved. Improvement, it is true, had been under way for some years; the cafeteria-style stock room, where each operator or repair man helped himself, was displaced some seven or eight years ago by a more business-like arrangement, and other improvements were made from time to time thereafter; but the present system was not fully developed and installed until 1939. As previously mentioned, it is based on commercial garage practice, with the primary purpose of assuring efficiency of labor and economy of materials. Secondarily, it is expected to provide a record of the maintenance and operating costs of the various classes of equipment and of individual equipment units—the former to be used in the preparation of budgets and estimates, and the latter as a guide to future selections and purchases.

It is barely necessary to mention that such a record must be maintained for several years before its full value is felt, and that any carelessness or let-down in the system will weaken, or perhaps even destroy its usefulness for these latter purposes.

The procedure is as follows: A repair shop ticket in triplicate is made by the shop superintendent for every piece of equipment entering the shop. The original is sent to the maintenance office record clerk, the duplicate to the stock room and the triplicate (card board) stays with the piece of equipment and the mechanic until the job is finished. As the necessary parts are needed, the mechanic requests them from the stock room, giving the shop ticket number and the identification number of the equipment. The store room clerk records each part and price on the back of the duplicate, and makes a corresponding entry on his daily charge-out sheet.

When the job is completed both the mechanic and the shop foreman sign the triplicate. The shop foreman writes on the face of the triplicate the nature of the repairs, at the same time recording the number of hours spent on the job. This record is also placed on the mechanic's daily time card. The time cards are given to the maintenance record clerk each morning. The triplicate, signed by mechanic and foreman, is delivered to the stock room and matched with the duplicate. These are given to

HIGHWAY DEPARTMENT
JACKSON COUNTY MISSOURI

RECONDITIONING ORDER — TRACTORS AND MISCELLANEOUS EQUIPMENT

MAKE | TYPE | YEAR | EQUIPMENT BY
MILEAGE | DATE RECEIVED | DATE RELEASED

ITEMS CHECKED IN THIS COLUMN NEED REPAIRS ACCORDING TO INSPECTION

INSTRUCTIONS FOR ACTUAL RECONDITIONING
CHANGE OIL | FLUSH-REFILL | DIFF'L | LUBRICATE

TRACTORS - ROLLERS
- MOTOR
- STARTER
- OIL PRESSURE
- FUEL PRESSURE
- FINAL DRIVE
- FLYWHEEL CLUTCH
- TRANSMISSION
- STEERING CLUTCH
- TRACK ROLLERS
- TRACK ASSEMBLY
- IDLERS

GRADERS
- MOTOR
- WHEELS & AXLE
- LIFTS & STEERING
- CIRCLE
- MOULD BOARDS

MISC. EQUIPMENT
- MOTOR
- WHEELS
- CONTROL

ENTERED BY | THE ABOVE WORK AUTHORIZED BY | ORDER
DATE | _____ | Nº 10976

Work Order for Tractors and Miscellaenous Equipment (Triplicate 6x9 in.)

MATERIAL USED						LABOR RECORD	
QUAN.	PART NO.	REQ. NO.	DESCRIPTION	PRICE		MECHANIC	HRS.
			ACCESSORIES				
			OIL AND GREASE				
			OUTSIDE REPAIRS				
			TOTAL				
INSPECTED BY						TOTAL	

Back of Work Order for Cars, Trucks, Tractors and Miscellaneous

HIGHWAY DEPARTMENT
JACKSON COUNTY, MISSOURI

Daily Time Card Date_____

Mechanic

Shop Order No.	Equip. No.	Hours	Amount
	Total		$

—7187 *Superintendent*

Garage Workman's Time Card (Single heavy manila stock 4x6 in.)

the maintenance record clerk, who matches them with the original which he has been holding. He transfers the time from the time card or cards to the back of the original shop ticket.

The total time is figured into dollars and cents and placed in the total column. A total of material and labor costs is also made. Both parts and labor are transferred to the permanent log. At the close of each month a recap is made showing labor and parts (actual and dollar and cents) for the month. The shop tickets are filed away for any further reference.

The *Equipment Operating Record,* commonly known as "the log," is made on 11 x 8½ in. sheets bound in heavy manila covers—a separate book for each power-operated machine. On the upper right hand corner of each cover is the identification number of the unit, and in the center is a brief description of it, the date at which the record begins, and a space in which to enter the date it closes. Each book is designed for a 12 month period. On the inside of the front cover is the tire and battery record. The gasoline, oil and repair record is made up of 12 pages, each ruled with 31 blank lines for daily entries.

Corresponding to the log for power-operated equipment, is the *Equipment Repair Record* for the non-power-operated. This consists of an 11 x 8½ in. blue card for each unit, printed with the same form on front and back.

As these records are built up they will give an exceedingly clear picture of facts essential to the economic maintenance and operation of equipment.

A column showing the number of hours worked by each powered machine each day would make a highly de-

HIGHWAY DEPARTMENT
Jackson County, Missouri Equipment No. Month 19

DATE	SPEEDOMETER	GAS.			OIL			DIESEL			ANTI-FREEZE			MISCL. ITEMS		MAINTENANCE COST					REMARKS
		SOURCE	GALS.	COST	SOURCE	QTS.	COST	SOURCE	GALS.	COST	SOURCE	KIND	COST	KIND	COST	SHOP #	PARTS	LABOR	TIRES TUBES	TOTAL COST	
1																					
2																					
3																					
4																					
30																					
31																					
TOTALS																					

Equipment Operation Record (12 pages 11x8½ in. bound in manila cover)

HIGHWAY DEPARTMENT
JACKSON COUNTY, MO.

EQUIPMENT REPAIR RECORD

Equipment No._____

Purchased From_____ From_____ 193__

Make_____ Model_____ Date_____ To_____ 193__

Date	Purchase Request	Shop Order	COST Labor	COST Material	Total Cost	REMARKS
		TOTAL				

—4201

Equipment Repair Card (Single blue card stock 11x8½ in.)

sirable addition, as with the present log form it is necessary to assume a full 8 hours for each day reported. As operations are kept as far as possible on a full day basis, this does not often lead to important error, but the change is desirable nevertheless. It would seem that the column for anti-freeze might be eliminated to make room for the record of hours. Anti-freeze could then be included with miscellaneous items.

by the tank truck operator and the other going to the maintenance record clerk, who enters the amounts and costs in the logs of the various pieces of equipment.

Each Highway Department employee requiring gasoline, oil or anti-freeze, at the Independence station fills out and signs an order slip which he delivers to the filling station attendant. The identification number of the equipment unit is included in this record. At the close of

HIGHWAY DEPARTMENT
Jackson County Missouri

Report No._____ By_____
Date_____
Day_____

—7168

TANK TRUCK DAILY REPORT

INVENTORY

MATERIAL	Gasoline (Gals.) Hi-Test	Gasoline (Gals.) Regular	Diesel Fuel	Motor Oils (Quarts) 10	20	30	40	K'r'sene (Gals.)		
Stock Previous Report										
Received This Date										
Total Stock This Date										
Distributed										
Balance on Hand										

DISTRIBUTION

Equipment or Barrel No.	Gasoline (Gals.) Hi-Test	Gasoline (Gals.) Regular	Diesel Fuel	Motor Oils (Quarts) 10	20	30	40	K'r'sene (Gals.)		
TOTAL										

Truck Tank Daily Report (Duplicate 8½x11 in. punched for binding)

Accounting for Fuel and Lubricants

All gasoline, oils and lubricants are received at the "bulk station," a record of such receipts being made in the upper portion of the "Tank Truck Daily Report." Distribution from the "bulk plant" to the filling station on the grounds, to equipment in the field and to the 16 maintenance districts is recorded in the lower, and larger, portion of the same report. Subtraction of each day's total distribution from "Total Stock This Date" provides a continuous record of quantities on hand. The tank truck report is made in duplicate, one copy being retained

the day the attendant enters all these orders on his daily report sheet, which is then filed with the maintenance record clerk. The form is closely similar to that of the tank truck report.

These explanations of the equipment maintenance and the gasoline and oil records, in conjunction with the copies of forms used, should give a clear picture of the system in all but minor details.

The various cards and sheets used in the repair and operating records are colored distinctively for convenience.

Gasoline and Oil Consumption by Various Units

The record system is already supplying interesting and valuable data. Later, this value will be greatly increased, providing, of course, that the records are continuously maintained. During my visit to Independence I was able to secure data directly from the "logs" for several machines. Other units had not been operated sufficiently since the records were started to yield significant results.

Each tractor or other power-operated unit (trucks and autos not included) is recorded as consuming 1½ lb. of grease, and 2 gal. of gasoline for cleaning per day operated. Each diesel motor using gasoline to start is recorded as using ½ gal. of gasoline per day operated. These quantities are estimated on the basis of average experience, it being obviously impractical to record such small amounts in daily routine operations.

In the succeeding tables, the number of days operated and the total quantities are taken from the records for each month, and from them I have computed fuel and oil consumption per hour. The hourly fuel rate is surprisingly uniform from month to month for similar ma-

Station No. 2—Independence, Mo. No. 103

JACKSON COUNTY, MO. ORDER FOR SUPPLIES

GOOD ONLY AT INDEPENDENCE, MO., STATION No. 2

Reg. Gas	Gals.	Oil—Medium	Qts.
Hi-Test	Gals.	Oil—Heavy	Qts.
Kerosene	Gals.	Anti-Freeze	Qts.

Car No. Date Signed

Filling Station Supply Orders (Single copy 6⅛x3¼ in.)

HIGHWAY DEPARTMENT
Jackson County, Missouri

Department
Date
By

DAILY GAS & OIL REPORT

INVENTORY

STOCK	GAS.—GALS. HI-TEST	GAS.—GALS. REG.	DIESEL GALS.	MOTOR OILS—(QUARTS) 10	20	30	40			KERO. GALS.		AMT.	
Previous													
Received													
Total													
Distributed													
Balance													

DISTRIBUTION

EQUIPMENT NUMBER	GAS.—GALS. HI-TEST	GAS.—GALS. REG.	DIESEL GALS.	MOTOR OILS—(QUARTS) 10	20	30	40			KERO. GALS.		AMT.	
TOTAL													

METER READINGS

Present													
Previous													
Distributed													

Filling Station Daily Report (Duplicate 8½x11 in. punched for binding)

HIGHWAY DEPARTMENT
Jackson County, Missouri

Report No. Dist No.
Period Ending

FOREMAN AND OVERSEER
GASOLINE AND OIL REPORT

EQUIPMENT NO. OR BARREL No. AND DATE	DISTRIBUTION Gasoline	DISTRIBUTION Diesel	DISTRIBUTION OIL (Qts.) No.	DISTRIBUTION OIL (Qts.) No.	RECEIPTS Gasoline	RECEIPTS Diesel	RECEIPTS OIL (Qts.) No.	RECEIPTS OIL (Qts.) No.	
TOTAL									

Foreman and Overseer's Monthly Gas and Oil Report (Duplicate 8½x11 in. punched for binding)

chines, while the oil varies widely—depending on the time it was changed and also on less obvious factors.

Crawler Tractor No. 1-17. 35 drawbar H. P. Purchased in 1936. March, 1940. Grading new road. 80 hours.
Diesel fuel ..... 73 gal. = 0.91 gal. per hr.
Oil ..... 14 qt. = 0.18 qt. per hr.

Crawler Tractor No. 1-22. 35 drawbar H. P. Purchased in 1939. March, 1940. Hauling rock wagons from quarry to crusher. 184 hours.
Diesel fuel ..... 164 gal. = 0.89 gal. per hr.
Oil ..... 48 qt. = 0.26 qt. per hr.

Crawler Tractor No. 1-23. 45 drawbar H. P. Purchased in 1939. March, 1940. Grading new road. 184 hours.
Diesel fuel ..... 202 gal. = 1.10 gal. per hr.
Oil ..... 88 qt. = 0.48 qt. per hr.

Crawler Tractor No. 1-18. 70 drawbar H. P. Purchased in 1937. March, 1940. Grading new road. 184 hours.
Diesel fuel ..... 324 gal. = 1.76 gal. per hr.
Oil ..... 102 qt. = 0.55 qt. per hr.

Crawler Tractor No. 1-11. 92 drawbar H. P. Purchased in 1935. March, 1940. Grading new road. 112 hours.
Diesel fuel ..... 300 gal. = 2.68 gal. per hr.
Oil ..... 64 qt. = 0.57 qt. per hr.

As a matter of curiosity, I figured the fuel and oil consumption per horsepower-hour from the foregoing data, and was surprised to note the uniformity of the rate for fuel. A small increase in efficiency with size of unit, and a moderate decrease with age might account for the entire variation. The efficiency of the older units also indicates good care. The variations in oil consumption are probably due to changes made in some cases just within the month of March and in other cases just without.

	Gallons Diesel Fuel per H. P.-hr.	Quarts Oil per H. P.-hr.
35 H. P. tractor purchased 1936	0.026	0.0051
35 H. P. tractor purchased 1939	0.025	0.0074
45 H. P. tractor purchased 1939	0.024	0.0107
70 H. P. tractor purchased 1937	0.025	0.0080
92 H. P. tractor purchased 1935	0.029	0.0062

Motor Grader Maintainer No. 18-3. Purchased in 1938

(The unit was engaged on miscellaneous maintenance work throughout the period, except in January, when it was used entirely on snow removal.)

	July 1939	Aug. 1939	Sept. 1939	Oct. 1939	Jan. 1940	March 1940
Hours operated	104	112	200	200	112	80
Diesel fuel—gal. total	130	171	204	193	122	209
Diesel fuel—gal. per hr.	1.25	1.53	1.02	0.96	1.09	2.61
Oil—qt. total	72	56	72	64	24	52
Oil—qt. per hour	0.69	0.50	0.36	0.32	0.21	0.65

Variations in hourly consumption of fuel, probably are due to differences in the character of work and the lengths of unavoidable idle while the machine was on the job.

Hydraulic Scraper No. 16-6. 12 Yards Capacity. Purchased in 1937

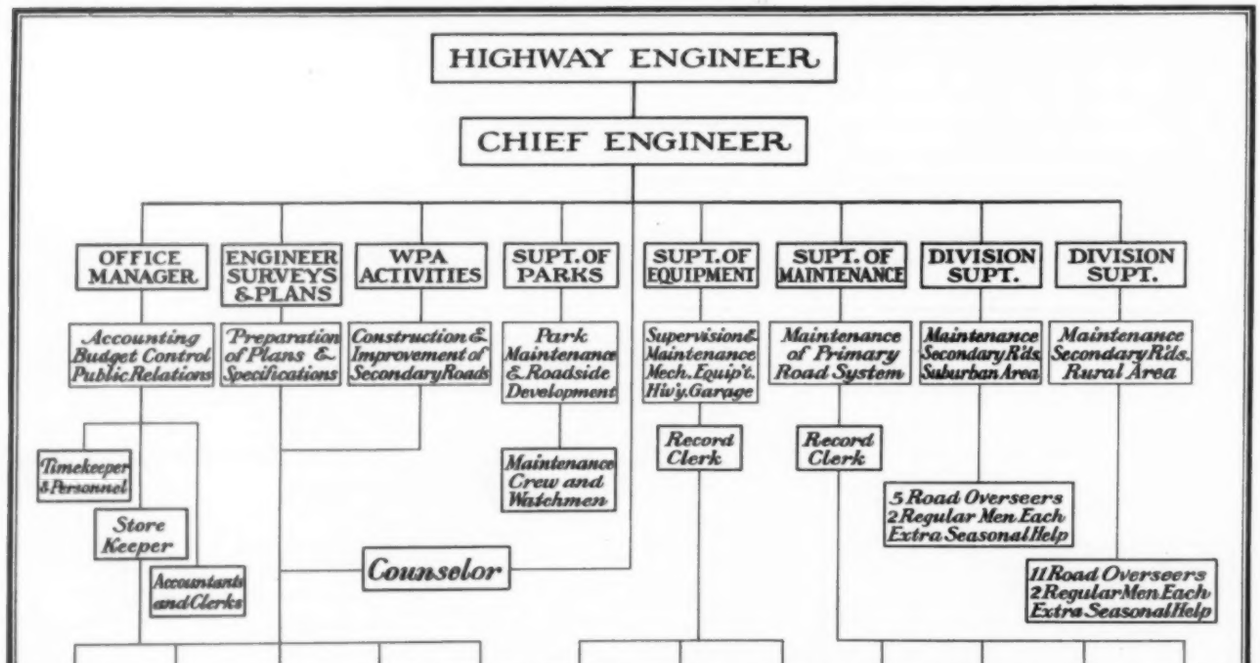
	Sept. 1939	Oct. 1939	Nov. 1939	Dec. 1939	March 1940
Hours operated	144	168	168	168	72
Gasoline—gal. total	124	192	159	222	85
Gasoline—gal. per hr.	0.86	1.14	0.95	1.32	1.18
Oil—qt. total	42	52	83	120	44
Oil—qt. per hr.	0.29	0.31	0.50	0.71	0.61

Truck Shovel No. 16-3. ⅜ Yard Dipped. Rebuilt 1936.

	July 1939	Jan., 1940 (Snow removal only)
Hours operated	80	120
Gasoline—gal. total	303	185
Gasoline—gal. per hr.	3.78	1.54
Oil—qt. total	48	12
Oil—qt. per hr.	0.60	0.10

Truck Shovel No. 16-4. ⅜ Yard Dipper. Rebuilt 1936.

	Sept. 1939	Feb. 1940	March 1940
Hours operated	144	96	96
Gasoline—gal. total	628	339	350
Gasoline—gal. per hr.	4.36	3.53	3.65
Oil—qt. total	64	17	27
Oil—qt. per hr.	0.44	0.18	0.28



Organization Chart of Jackson County Highway Department

Crawler Shovel No. 16-15. ⅝ Yard Dipper. Purchased in 1937.

	Oct. 1939	Feb. 1940	March 1940
Hours operated	112	64	96
Gasoline—gal. total	578	463	558
Gasoline—gal. per hr.	5.16	7.23	5.82
Oil—qt. total	64	40	68
Oil—qt. per hr.	0.57	0.62	0.71

Bucket Loader No. 16-2. Buckets 668 cu. in. each. Rated capacity 1 cu. yd. per minute in free flowing material. Purchased in 1934.

	Oct., 1939	Feb., 1940
Hours operated	160	160
Gasoline—gal. total	120	146
Gasoline—gal. per hr.	0.75	0.91
Oil—qt. total	9	30
Oil—qt. per hr.	0.056	0.187

3 Highway Mowers powered with 85 H. P. automobile engines.

	June 1939	July 1939	Aug. 1939	Sept. 1939	Oct. 1939
Mower No. 14-4. Purchased in 1938.					
Hours operated	184	184	184	184	.....
Gas.—gas total	173	170	170	170	.....
Gas.—gal. per hr.	0.94	0.92	0.92	0.92	.....
Oil—qt. total	21	15	32	26	.....
Oil—qt. per hr.	0.114	0.082	0.174	0.141	.....
Mower No. 14-5. Purchased in 1938					
Hours operated	184	192	200	184	208
Gas.—gal. total	197	202	194	178	193
Gas.—gal. per hr.	1.07	1.05	0.97	0.97	0.93
Oil—qt. total	19	10	18	21	25
Oil—qt. per hr.	0.103	0.052	0.09	0.114	0.121
Mower No. 14-14. Purchased in 1939.					
Hours operated	176	192	200	184	208
Gas.—gal. total	116	132	146	123	139
Gas.—gal. per hr.	0.66	0.69	0.73	0.67	0.67
Oil—qt. total	11	6	17	3	6
Oil—qt. per hr.	0.062	0.031	0.085	0.016	0.029

Air Compressor No. 11-2. Capacity 240 C.F.M. Purchased in 1928.

	March, 1940
Hours operated	146
Gasoline—gal. total	455
Gasoline—gal. per hr.	3.12
Oil—qt. total	92
Oil—qt. per hr.	0.63

Air Compressor No. 11-1. Capacity 110 C.F.M. Purchased in 1929.

	March, 1940
Hours operated	152
Gasoline—gal. total	245
Gasoline—gal. per hr.	1.61
Oil—qt. total	13
Oil—qt. per hr.	0.086

Administration

The Jackson County Highway Department is headed by Alex F. Sachs, Highway Engineer; directly under Mr. Sachs is J. E. Schnittger, Chief Engineer; and reporting to Mr. Schnittger are the various engineers, superintendents and others. Organization of the department is clearly indicated on the accompanying chart.

Alex F. Sachs, Highway Engineer

COST OF PREFRAMING TIMBER FOR BRIDGES

In a paper presented at the 36th annual meeting of the American Wood Preservers' Association (Jan. 23-29, 1940), Mr. G. N. Trout, Bridge Engineer, Union Pacific Railroad System, Omaha, Neb., gave the following data on the cost of preframing timber for use in bridges on that railroad:

The preframing of complete tie and guard rail timber renewal for trestle bridges requires 1/3 man-hour per foot of bridge.

The preframing of timbers for a ballast deck trestle bridge requires 1½ man-hours per foot of bridge.

The preframing of timbers for complete deck renewal of trestle bridges, which includes stringers, ties and guard rail timbers, requires 1 man-hour per foot of bridge.

The preframing for complete tie and guard rail timber renewal for steel bridges on tangent track requires 1 to 1½ man-hours per each tie used on the bridge, according to size of ties required.

The preframing for complete tie and guard rail timber renewal for steel bridges on curved track requires about 1½ times that required for timbers on tangent track bridges.

The average cost per thousand feet BM of timber preframed for obtaining the field data is: For complete decks of trestles, $0.35; for deck of steel bridges, $3.95.

The average cost per thousand feet BM for preparing the plans is: For complete decks for trestles, $0.35; for decks of short I-beam spans, $3.50; for decks of girder spans less than 100 ft. in length, $1.00; for decks of girder or truss spans more than 100 ft. in length, $0.90.

SAFE-SPEED SIGNS FOR CURVES REDUCE ACCIDENTS

Signs indicating a safe maximum speed for all curves on a 95-mile section of Road 37 between Indianapolis, Ind. and Paoli, Ind., were installed in 1939 by the Indiana State Highway Commission to determine the value of such markings in decreasing traffic accidents. The suggested speeds were determined by mounting an airplane bank indicator in an automobile which was driven over the test section at varying speeds.

At the end of a year in which curve speed signs had been in place, the state highway traffic engineers reported that although there was a 15 per cent increase in traffic on the test section—in comparison with the preceding 12-month period—there were 10 fewer fatalities; 12 fewer persons injured; 36 less accidents on curves; 33 fewer persons injured on curves; and seven fewer fatalities on curves; with approximately $9,000,000 less property damage reported in accidents on the 95-mile test section.

During the 12-month experiment, conflicting reports were received from motorists using the road — some contending that the speed indicated was too fast and others that it was too slow, a difference of opinion seemingly based upon the type of vehicle operated. A great majority of the comments received favored the curve marking.

Recommendations of the traffic engineers accompanying the report to the state highway commission include continuation of the test for a longer period and the possible extension of the experiment to some other highway.

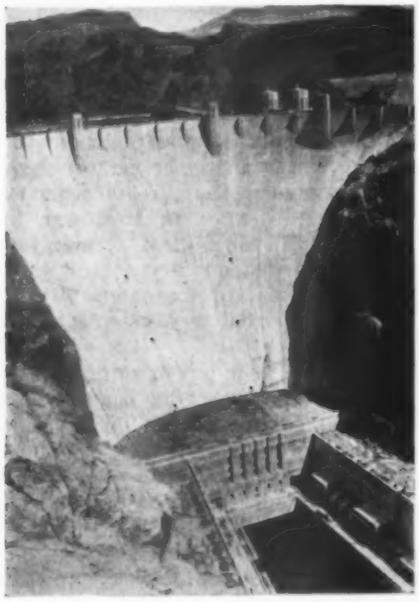
OBSERVATIONS BY THE WAY

By
A. PUDDLE JUMPER

¶ One Sunday afternoon on my last trip thru the Southwest I drove from El Paso to Austin, Texas. Of course, no grass grew under the wheels of the car. I want to state, without appearance of exaggeration, that those Texas highways are top notch. The state is being converted into a garden of Eden. Mile after mile I sped along table-top-smooth bituminous and concrete road surfaces bordered by beautiful, natural landscaping. As darkness crept on I was struck by the reflector buttoned curve outlines, danger points, and signs. Every curve was clearly outlined for several hundred feet ahead. At one place, the word "CURVE" was spelled out in reflectorized letters about 24 in. high. It was commanding. There lies the secret of the prevention of many accidents.

• •

¶ This is Boulder Dam. A state highway transverses the curved top.



You're looking down about 700 ft. The roadway on top is very narrow.

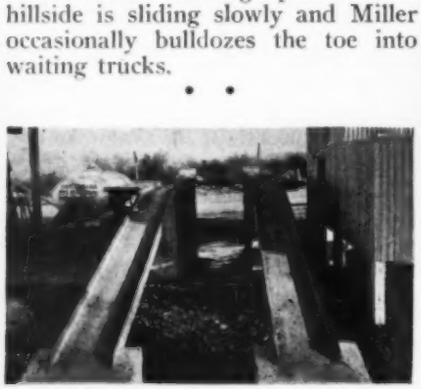
¶ Did you know that Prof. A. Diefendorf, Head, Department of Civil Engineering, University of Utah, is giving a 6 weeks lecture course before the Mexican Federal Engineers at the University of Mexico? It is being done at the request of the Mexican Government.

• •

¶ The chute shown here was built by Carl Miller, Maint. Supt., California, on a section of U. S. 101, to bulldoze the flowing foot of a slide

into trucks. The large piece of the hillside is sliding slowly and Miller occasionally bulldozes the toe into waiting trucks.

• •



¶ Grease rack at the Nevada shops at Las Vegas. Made from I-beams from old bridges.

• •

¶ W. E. Grace Mfg. Co. of Dallas has certainly expanded. Now located in much larger quarters just south of town.

¶ A new type of traffic marking to me was this arrow painted on the pavement to show motorists when they could cross the center line to pass a car ahead. This is on Little

Washoe Summit on the road between Carson City and Reno, Nevada, on U. S. 395. 1940 plans call for a change from this.

• •

¶ Nevada adopted the wavy line at a grade crossing in Washoe Valley on U. S. 395, ten miles north of Carson City. Only one accident has oc-

curred at this curve and crossing since the wavy line was placed. Prior to it there were frequent smashups on the curve.

• •

¶ At Squaw Rock on U. S. 101 in Calif. I stopped one evening to take a picture of a peculiar piece of bridge construction. I did a lousy job of photography so cannot show the picture. The bridge crosses a gully through which a slide is flowing. The

superstructure is built to move upon the substructure. The substructure consists of capped trestle bents. On top of the cap, another timber, the same size as the cap, is free to move longitudinally of the cap, which is transverse to the center line of the road. On this second cap the floor stringers rest. As the slide from the mountain side moves toward the river at Squaw Rock, it may push the trestle bents out of line, but the superstructure of the bridge will remain in place. Engineering ingenuity, I calls it.

• •

¶ Another type of pavement marking on a curve and grade crossing near Steamboat Springs, Nevada, is

supported with reflector standards as an added safety feature.

• •

¶ Railroad crossing in Washoe

City, a ghost town between Carson City and Reno, Nevada.

• •

¶ Lowest road in the Western hemisphere—280 ft. below sea level. The salt water pond at the left is

called Bad Water. This is the road leading from Furnace Creek Inn in Death Valley, Calif.

¶ Who said it never rained in a desert? A. P. J.'s car on the road north from Baker in the Mojave

Desert plowed through eight or ten places where rain waters from the previous night were sweeping over

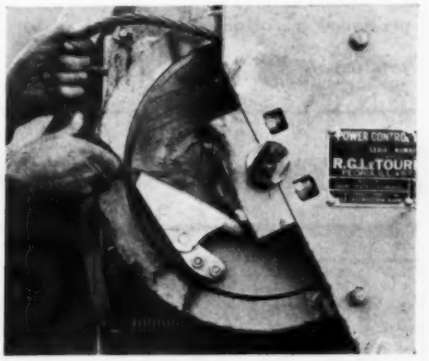
the highway. In a few places, culvert pipe were sufficient to carry the flow. The flow was so strong that boulders and niggerheads were rolled along.

• •

¶ The joint on the water supply line to a paver on the Arroyo Seco job just out of Pasadena, Calif., was

new to me. It certainly is a time saver. The pipe lengths can go off at an angle to one another. That's a rubber hose alongside.

¶ Here's what looked like a good idea to me. It's a device designed by H. J. Hagen, Road Contractor of



Globe, Ariz., for attaching the end of a wire rope to a drum or elsewhere. Photo shows preformed wire rope on power takeoff being attached to takeoff drum on a tractor. He also used them on the drums of his power shovels.

• •

¶ A survey shows Yale graduates have 1.3 children and Vassar graduates have 1.7 children. This proves, of course, that women have more children than men.

• •

¶ Following is a statement I saw in Vol. IV of the Eastman report; you, also, may get a thought from the footnote:

"Early Steps Toward a Rational* Design."

*The word "rational" as used here means not merely "reasonably" (the ordinary sense), but more precisely "attained by reason" (in a theoretical sense). A rational equation is deduced from general laws of nature, and applies with equal certainty to the range of observations as well as beyond it. It is distinguishable from an empirical equation, which may be a satisfactory expression of observations, but which may not express any law, and which cannot be depended upon beyond the observed limits.

• •

¶ An old jallopy drove up to a bridge toll booth.

"Fifty cents," said the collector.

"Sold," said the driver and walked across.

• •

¶ Harvey Briggs of Texas sees possibility of Gibb Gilchrist turning out salesmen and politicians from Texas A. & M. instead of engineers. Gibb sponsors the idea that students should take more cultural and social subjects in college while students instead of specializing on some phase of engineering. Did Harvey express himself at the last Texas A. & M. Highway Engineering Short Course, or did he? Gibb laughed himself sick again and had to go back to bed.

America's first commercial oil well, opened near Titusville, Pa., in 1859, produced gasoline as a worthless by-product.

American Road

WASHINGTON, D. C.

ARBA TO STAGE 1941 CONVENTION

Down the Road

by CHARLES M. UPHAM
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ROADS AND FREEDOM

The rockets' red glare,
The bombs bursting in air,
Gave proof through the night
That our flag was still there.

More than a century has passed since Francis Scott Key penned immortal words. His song, which so eloquently expressed the spirit of '76, has never been more meaningful than in 1940. Today, a United States at peace is firm in its hard-won right to life, liberty and the pursuit of happiness, free from control by any nation across the sea.

Americans celebrated Independence Day this year with more than usual thought for the significance of the occasion. July 4 orators found new meaning in the phrases, "freedom of speech," "freedom of the press" and "freedom of worship." These constitutional guarantees can no longer be taken for granted and forgotten. The citizen's rights are being destroyed with alarming speed in the Old World. The United States is forced to embark on a gigantic preparedness program. The nation must make ready to defend its rights if the need arises.

The possibility of foreign invasion of these shores is no pleasant consideration. America has in the past rested secure in the confidence that two oceans are protection enough. Today, that confidence is shaken. Adequate defense has become one of the nation's most important needs. We must now be prepared to meet attack on either coast. Although we are speedily taking steps to increase the size of our armed forces, we cannot expect to build up an army large enough to defend our long eastern costline, plus a duplicate force that can always be stationed in the West.

Instead, we must have a mobile army that can quickly move from place to place. If we are attacked on the West Coast, when our main forces are stationed in the East, it must be possible to send help to the invaded area with the least possible delay. The United States Army is doing its best to make rapid transportation possible. Every branch is speeding up the addition of motorized units. The growth of rapid, mechanized fighting equipment has been phenomenal. Our men, arms and supplies are today carried on rubber-tired wheels. Unfortunately, however, rubber wheels and gasoline and diesel engines are not the only requirements for rapid movement. Our hopes for the future may some day be in the hands of America's armed forces. Their ability to fulfill these hopes may in turn rest on America's highway system.

How well are our highways prepared to meet the test of modern warfare? You received a striking answer to that question if you, like thousands of other Americans, celebrated the Fourth of July with a motor trip. You found the highways congested and incapable of meeting the demands of modern traffic. You lost many minutes in traffic tie-ups, minutes that might be priceless to an army in wartime. If you left the main highways, you found many miles of unimproved dirt roads, roads over which foodstuffs must be transported from the farms to the army in wartime. You probably experienced at least one narrow escape from accident at a sharp curve, railroad grade crossing or some other highway hazard. You returned home at night with darkness added to the other dangers of driving. And you read reports of hundreds of deaths and injuries due to holiday traffic in your morning newspaper.

The traffic that you found on the roads on July 4 was small in comparison to the numbers that must use these same roads in wartime. The inadequacy of our highways becomes increasingly apparent as we consider the need for speed in the transportation of troops, arms and supplies. We must strengthen our army, navy and air force. We must also perfect our highway system that we may be always certain of an affirmative answer to the query,

Oh say, does that star-spangled
banner yet wave
O'er the land of the free and
the home of the brave?

ARBA TO STAGE 1941 CONVENTION IN NEW YORK CITY, January 27-30

Highway Economics Division To Convene For First Session

"Roads for Defense" will theme note the 1941 Convention of the American Road Builders' Association in New York City, January 27-30. The Pennsylvania hotel has been named convention headquarters. The annual banquet will be staged at the Waldorf-Astoria. Robert W. Moses, commissioner of New York City's department of parks, has offered the fullest co-operation of his office to convention delegates. Through this department, inspection trips are planned to parkways, tunnels, elevated highways, bridges and all the other modern construction projects for which the city is noted. The New Jersey State Highway Department will arrange similar trips and the New York City engineer's office will place its facilities at the disposal of the Road Builders. A special trip to LaGuardia Airport is also scheduled.

War Department representatives will be on hand to discuss the timely convention keynote, "Roads for Defense." They will participate in an open forum on military roads. Discussions of the particular specifications required for military highways will make this forum of special interest to highway contractors. Another highlight of the 1941 conclave will be the first session of the new ARBA Highway Economics Division. The Public Relations Division will sponsor an open forum on the industry's public relations problems.

ARBA PLANS STUDY OF HIGHWAY ECONOMICS

Important information about highway costs and benefits will be released to the highway-using public by the Highway Economics Division, which is now being formed by the American Road Builders' Association. The division will conduct studies to determine to what extent federal-aid appropriations should be increased, what improvements are needed to make our highways meet modern traffic demands, the effect of highway construction on employment and its value to industry. This data will be particularly useful in bringing about the enactment of highway legislation and in anti-diversion campaigns. It will be released to the public through newspapers, magazines and radio.

Builders' Review

Rural sidewalks along state highways have reduced pedestrian accidents in Massachusetts 36 per cent.

AUGUST, 1940

IN NEW YORK CITY, JANUARY 27-30

The ARBA Executive Committee Picks New York City for the 1941 Convention. Pictured at a Meeting in New York, June 24-25, Left to Right, are Contractors' Division President Herbert R. Anderson, President, Illinois Road Builders' Association, Chicago; Manufacturers' Division President William M. Parrish, industrial sales executive, International Harvester Co., Chicago; ARBA President Hal G. Sours, Assistant Director and Chief Engineer, Ohio Department of Highways, Columbus; ARBA Engineer-Director Charles M. Upham, ARBA Director Robert B. Brooks, Member, Missouri State Highway Commission, St. Louis, Mo.; ARBA Vice-President Paul B. Reinhold. President, Reinhold & Co., Pittsburgh, Pa., and ARBA Treasurer Herbert C. Whitehurst, District of Columbia Director of Highways, Washington.

J. E. DODSON HEADS ARBA FLORIDA GROUP

The annual meeting of the Florida Section, ARBA, was held in Tallahassee, June 17. J. E. Dodson, Miami, was elected to succeed S. B. Brinson, Tampa, as chairman. New vice-chairman is Charles W. Smith, Pensacola. H. M. Birtley, Tallahassee, was re-elected secretary. A barbecue at the American Legion home followed the meeting.

PUBLIC RELATIONS DIVISION ADDS FOUR NEW DIRECTORS

Directors of the Public Relations Division of the American Road Builders' Association who were appointed to the board during the past month include Taylor G. Soper, executive secretary, Illinois Road Builders' Association; Merton S. Heiss, managing editor, "Kiwanis Magazine," and John Jenkins, automobile editor, "Chicago Daily News," all of Chicago, and Paul L. Andrews, executive secretary, Georgia Highway Contractors' Association, Atlanta.

ARBA PLANS PUBLICITY FOR 1941 CONVENTION

The ARBA Manufacturers' Division Publicity Committee set in motion its campaign to publicize the association's 1941 convention at a meeting in Chicago. Subcommittees, which will closely cooperate with the association, were appointed as follows: PROGRAM—G. M. Walker, advertising manager, Caterpillar Tractor Co., Peoria, Ill., chairman; E. J. Goes, advertising manager, Koehring Co., Milwaukee, Wis.; H. A. Scribner, Russell T. Gray, Inc., Chicago, and ARBA Director Victor J. Brown, publishing director, "Roads and Streets," Chicago. PLANS—George C. Williams, advertising manager, Northwest Engineering Co., Chicago, chairman; E. T. Slackford, advertising manager, Harnischfeger Corp., Milwaukee, and L. L. Jacobs, Buchen Co., Chicago. BUDGET—William M. Parrish, industrial sales executive, International Harvester Co., Chicago, and ARBA Manufacturers' Division president, chairman, and ARBA Manufacturers' Division Directors George J. Dimond, mixer and paver sales manager, Koehring Co., and B. F. Devine, sales manager, construction equipment division, Chain Belt Co., both of Milwaukee. MECHANICAL—H. F. Barrows, advertising manager, Austin-Western Road Machinery Co., Aurora, Ill., chairman; J. L. Beltz, advertising manager, Thew Shovel Co., Lorain, Ohio, and ARBA Manufacturers' Division Director Edgar J. Buttenheim, publisher, "American City Magazine," New York City. Ex-officio members of all subcommittees are Frank O. Wyse, publicity manager, Bucyrus-Erie Co., South Milwaukee, Wis., Publicity Committee chairman, and Robert E. Harper, ARBA director of public relations, Washington, D. C.

1941 Convention Program Subcommittee Plans Activities. Victor J. Brown and Chairman Gerald M. Walker Are Seated, While H. A. Scribner and E. J. Goes Stand.

RECENT PATENTED BITUMINOUS PAVEMENTS

By GEORGE W. ECKERT*
Missouri State Highway Department

THE JULY 1939 issue of ROADS AND STREETS summarized the patents on bituminous pavements granted between January 1921 and January 1939. Since the latter date, a number of patents on bituminous pavements have been issued. These recent patents may be classified as to (a) methods of bituminous pavement construction, (b) bituminous pavement construction involving soil stabilization, and (c) bituminous paving compositions.

Methods of Bituminous Pavement Construction

Utilizing Dense and Open Types Mixtures—J. H. Conzelman (1) has indicated some advantages and disadvantages of dense type mixtures and open type mixtures in pavements and has offered a procedure of pavement construction which embodies a combination of the dense and open type mixes to take advantage of their best qualities. A dense mix prevents moisture from entering the base but an open mix gives the best conditions for non-skid surfaces. The method of utilizing these two types of mixtures by Conzelman involves the steps: (a) the preparation of a dense mix of which a portion is spread on the base, (b) addition of coarse aggregates to the balnace of the mix, and (c) laying this admixed material over the dense mix layer. This procedure is intended to give a lower dense impermeable layer and an upper skid resistant open type layer. The coarse aggregate added to the dense mix for the upper surface is preferably hard and abrasive and lightly coated with bitumen. Any method of mixing the coarse aggregate with the dense mix is applicable which intimately mixes the two materials and not merely imbeds the aggregate in the upper surface. The pavement is constructed such that the upper layer merges into and is integral with the lower layer.

Cold-Lay Bituminous Pavement—A cold-lay bituminous pavement patented by F. S. Fleckenstein (2) involves (a) the application of a wearing course of aggregate to a foundation, and (b) the application of a surfacing course of bitumen-coated aggregate. The first

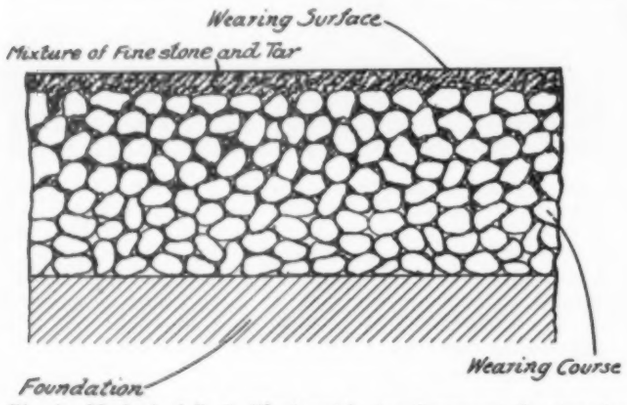

Fig. 1—Method of F. S. Fleckenstein for Pavement Construction

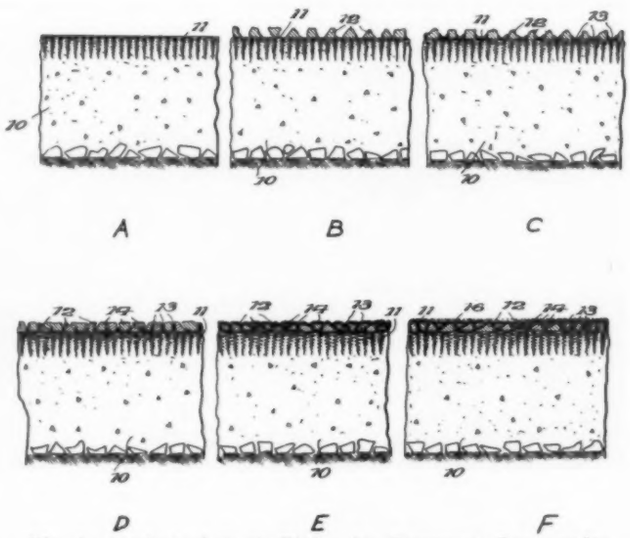

Fig. 2—Method of S. E. Finley for Pavement Construction
A. Foundation with Application of Prime Coat. B. Application of Portion of Cover Course of Aggregate to the Primed Base. C. Application of a Portion of the Bitumen to the Aggregate. D. Application of Balance of Cover Course of Aggregate. E. Application of Balance of Bituminous Cement. F. Sectional View of Completed Pavement

course consists of uncoated mineral aggregate such as crushed stone or slag, preferably material passing a screen with circular openings of 3 in. diameter and retained on a 1 in. screen. These stones are rolled to the desired contour of the road. The wearing surface applied over the large stone is a mixture of finely divided mineral particles and bitumen, preferably coal tar. An aggregate found suitable for the wearing surface consists of the grading:

Passing ¼ in. screen	90-100%
Passing No. 10 sieve	50-95%
Passing No. 200 sieve	0.15%

The bitumen may be a straight distilled tar of specific viscosity Engler of 25-65 at 40°C. or a cut-back of specific viscosity Engler of 40 to 60 at 40°C. The amount of tar in the mixture is preferably 8-10 per cent, so that the mix is readily spread at atmospheric temperature and so that the mix has sufficient fluidity under pressure to flow into the interstices of the underlying stone layer to key the stones and cement them together. Also, 8-10 per cent tar permits a certain amount of tar to be squeezed out of the mix into the lower layer of stone to coat some of this aggregate. By rolling, a dense wearing surface bonded with the underlying wearing course is formed.

Surface Treatment Process—To overcome some disadvantages of the inverted penetration type pavement, S. E. Finley (3) has developed a surface treatment process which is intended to give a pavement with more desirable qualities at a lower cost and to be more

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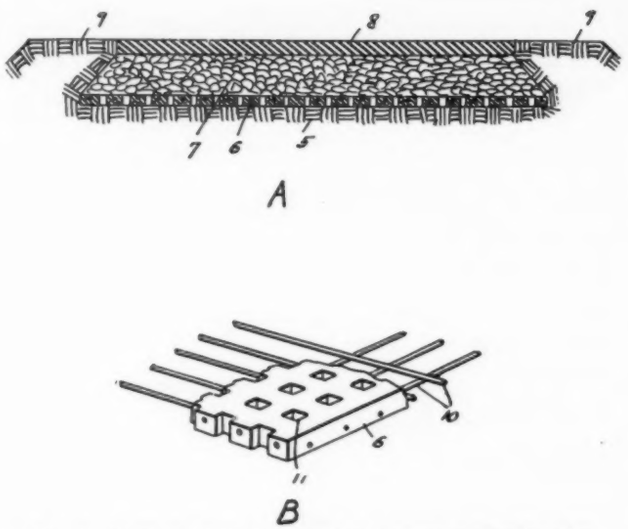

Fig. 3—Method of R. J. Shaw for Pavement Construction
A. Cross Sectional View of Pavement: 5—Usual Subgrade. 6—Grid. 7—Aggregate Base Course. 8—Pavement. B.—Reinforced Grid

quickly constructed than pavements built according to the present surface treatment practice. The new method comprises the steps:

(a) application of a prime coat on the foundation
(b) application of a portion of the cover aggegate to the primed base (50-60 per cent of the aggregate—25-30 lb. per sq. yd.)
(c) addition of a portion of the bituminous cement to the aggregate (about half—.25 to .3 gal. per sq. yd.)
(d) application of the balance of the cover course aggregate (20-25 lb. per sq. yd.)
(e) application of the balance of the bituminous cement
(f) compaction by rolling
(g) application of a cover of fine non-coated or precoated aggregate.

The object of the Finley process is to overcome certain disadvantages of the practice in which all the bituminous cement (.4-.6 gal. sq. yd.) is applied over the prime coat and then all the aggregate applied over the bitumen. In this prior practice, the disadvantages are listed as:

(a) lack of satisfactory bond of pavement to foundation
(b) waste of aggregate (material not bonded by bitumen is removed by sweeping)
(c) minimum temperature of aggregate-application is 70°F.
(d) time limitations — practically 5 months in which construction is prohibited.

The process developed by Finley is purported to be an improvement in that (a) good bond is provided by imbedding some stone in the foundation, (b) all aggregate is bonded together (c) minimum temperature of application is reduced, and (d) time available for construction is increased.

Paving Process—M. H. Irvine (4) has described a paving process in which successive applications of a cut-back are given to a layer of aggregate. In this method, from ⅛ to ¼ gal. sq. yd. cut-back is added in each application, and after each application sufficient time is allowed for at least partial evaporation of the solvent. The number of applications may vary from two to ten depending on the conditions of the road material. The asphaltic cut-back can vary in Saybolt furol viscosity from 30 to 130 at 77° F. The purpose of the process is to provide a pavement having zones of different asphalt content. The asphalt content is higher in the upper zones. Thus, with four applications of cut-back, the upper zone has 4 coatings, the next lower zone has three coatings, the next a double coating, and the last a single coating. This is designed to provide maximum stability at the surface of the pavement where maximum stresses due to wheel load occur.

Pavement Reinforcement—A method of reinforcing a pavement as patented by R. J. Shaw (5) consists of placing a grid between the usual base course and the subgrade. A preconstructed concrete grid (or asphaltic grid) is placed on the subgrade, and the aggregate for base course is placed over the grid. A matrix type oil pavement or other similar pavement is then laid on the base course to provide the finished road. The purpose of the grid is to provide resistance to tensile strains in the base course by distributing the wheel load over the subgrade.

Subgrade Protection—A method of protecting the subgrade has been developed by E. B. Sparrow (6) in that drain tiles are placed between the subgrade and pavement as shown in Fig. 4. A layer of sand for cushion effect is placed on the subgrade and the tiles laid on the sand cushion. The pravement material is spread over the tiles. The function of the tiles is to drain off moisture which passes through the pavement and moisture which rises from the subgrade. Tiles may also be used to prevent water from entering the subgrade from the sides of the highway. Another function of the tiles is to provide an air space between the subgrade and pavement in order to reduce temperature variations in the subgrade such that expansion, contraction, and freezing are diminished. The tiles can be of load bearing type of of non-absorbent nature.

Improving Penetration of Bitumen—K. Dammann (7) has devised a means of improving the penetration of bitumen into road surfaces for those cases in which hot asphalt or hot tar is used in the penetration type of construction. The basic feature of the improvement is the application of suction to the road surface to remove excess air in order that the hot bitumen can better penetrate the pores of the road structure. Figure 5 illustrates the method as described by Dammann. The bitumen is heated and run into the rectangular carrier element which passes over the road surface. The carrier is kept filled with a sufficient amount of hot bitumen so that the bitumen is not cooled too much by contact with the aggregate of the road as occurs in the ordinary penetration methods. Rubber or the like is used to give a seal between the sides and ends of the carrier with the road surface. A vacuum pump connected by a suction line with suitable suction heads in contact with the road surface removes air and moisture from the pore spaces. The suction heads in the carrier are covered with bitumen to prevent re-entry of air.

Pavement Construction Involving the Stabilization of Soils

Eliminating Damage by Frost Heaving—A. R. Chambers (8) has developed a method of pavement

Fig. 4—Method of E. B. Sparrow for Pavement Construction

construction designed to eliminate damage by frost heaving in those areas subjected to sub-zero temperatures. The method consists of adding electrolyte to the soil base and waterproofing the mixture with bituminous material. In the process of constructing pavements by the Chambers' method, the sub-base is scarified, mixed thoroughly with a salt such as sodium chloride to a predetermined depth, moistened, and compacted. This subbase is primed with about 0.5 gal. per sq. yd. of tar or asphalt primer, over which is laid a course of gravel, sand, and clay, the mixture preferably placed in layers and containing salt. The surface course is laid over this base course. The amount of electrolyte to be used in the subbase is determined in the Chambres' patent by the formula:

$$B = 165\ a\ x\ y\ z\ m$$

where:

B is tons of salt per mile
a is percent by wt. of subbase material passing No. 40 screen expressed as decimal fraction.
x is average specific gravity of the subbase material.
y is the thickness of the subbase layer in feet.
z is the width of the road in feet.
m is the percent of salt expressed in decimal fraction required to protect against a certain temperature, as illustrated in the following table:

% salt in soil fines	*freezing point °F.*
1.25	26
2.50	19
3.75	13
5.00	5
6.25	—6

In certain situations, thin layers of bituminous waterproofing material may be placed at intervals in the electrolyte-soil subbase mixture to improve retention of the electrolyte. The subbase may also be waterproofed at the bottom and sides with bitumen before backfilling with the electrolyte stabilized soil. The salt may be added as solution to the subbase instead of mixing the crystalline material with the soil.

Maintaining Proper Moisture Balance in Soil Base—The maintenance of a proper balance of moisture in a soil base is the purpose of a method patented by J. B. Warden (9). The essential feature of the process is the admixing of a finely divided bituminous composition with the soil. The pulverized bituminous composition may be admixed throughout the depth of the pavement or only throughout a surface layer. The bituminous composition may be accompanied with a deliquescent salt, or a layer of deliquescent salt may be placed intermediate the depth of the pavement. The bituminous composition may comprise any admixture of bitumen and a substance substantially insoluble in water and capable of taking up water, such as clay. The composition should be of such hardness that it can be pulverized and the bitumen should not have a penetration greater than

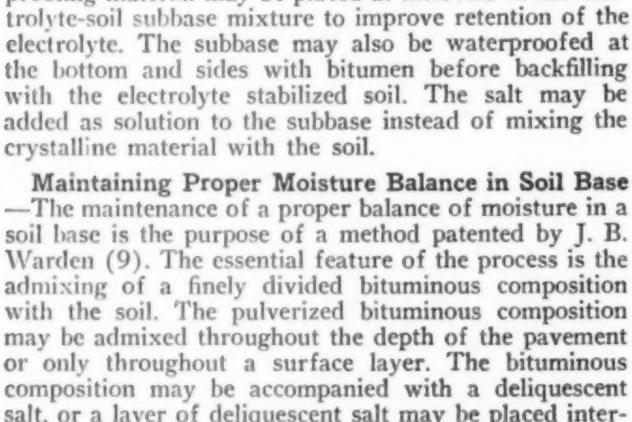

Fig. 5—Method of K. Dammann for Applying Bitumen to Road Surfaces

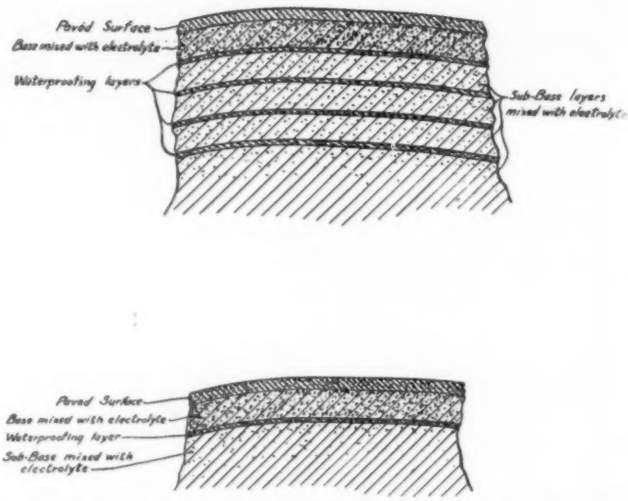

Fig. 6—Method of A. R. Chambers for Pavement Construction

20 at 77°F. An example of such a bituminous composition is:

Native Trinidad asphalt	39-56 %
Colloidal clay	25-45 %
Deliquescent salts	0.5%
Water	5-33 %

The amount of bitumen in the final stabilized soil mixture may range from 3 to 10 per cent by weight of the soil. In the construction of a pavement according to the Warden process, the soil is mixed with such materials as limestone screenings or the like as desired, and then with the bituminous composition. The mixture is wetted and rolled. This may be used as a pvaement or as a base or foundation for any other form of wearing surface. The advantages of using the finely divided bituminous composition as listed by Warden are:

(a) the clay plus any deliquescent salts maintain proper moisture balance.
(b) the bitumen promotes a degree of bonding of the soil particles without coalescence of the bituminous material.
(c) the particles of the bituminous composition at the surface imparts resistance to dusting and wear under traffic.

Process for Pavement Construction—H. A. Ingalls (10) has developed a process for pavement construction in which the soil is treated first with water and then with an oil. The pavement is constructed by reducing the soil to a finely divided state, next agitating the soil in the presence of water to give a fairly moist mass, then adding oil in such a manner that it is stratified between layers of moist soil, and finally compacting the treated soil to a densely packed and homogeneous condition. The application of pressure by compaction results in the distribution of the oil throughout the treated soil. For a pavement of 6 in. thickness, one layer of oil injected to a depth of 6 in. from the upper surface may be sufficient. The application of pressure on the surface brings the oil upward from the position at which it was injected. The Ingall's process includes the treatment of soils with (a) heterogenous liquids of different density, (b) water and a viscous structural liquid which has a rensity less than water, and (d) water and oil. The water is added to the soil to facilitate the distribution of the oil throughout the soil layer. At the time of injection of the oil below the surface, steam or heated air may be used to atomize the oil ejected from the distributing tube and to force the oil upward throughout the loose soil.

Bituminous Paving Compositions

Increasing Bitumen Content of Rock Asphalt—J. H. Conzelman (11) has patented a process for increasing the bitumen content of rock asphalt for the production of cold lay paving mixtures. He has found that by heating rock asphalt in the presence of a small amount of non-bituminous mineral aggregate, and mixing with an emulsified flux oil and with the necessary per cent of asphalt cement, a stable, workable, and properly graded cold lay mixture can be produced. The production of a cold lay type mix of the nature specified requires the control of the mixing temperature, the per cent of non-bituminous aggregate, and the amount of water added to the mixture. A typical limestone rock asphalt pavement mixture as produced in the Conzelman process is:

Rock asphalt (containing 20 per cent added sand)	1,882 lbs.
Emulsified flux oil	35 lbs.
Water	18 lbs.
Asphalt cement	65 lbs.

The basic principle of the Conzelman process is that in the mixing procedure, after emulsified oil and asphalt cement have bene added, some of the non-bituminous aggregate is stripped of bitumen by the water so that, after cooling, the rock asphalt mixture is workable. After mixing and partial stripping, the percentage of uncoated particles is low enough so that after the mixture is laid and is subjected to traffic and solar heat the particles take up sufficient bitumen from the coated aggregate to be well bonded.

Preparation of Paving Mixtures—The incorporation of sulfur, iron sulfide, and calcium carbonate with asphaltic sand rock is the basis of a patent granted to G. J. Hines (12) for the preparation of paving mixtures. From 3-10 per cent sulfur, 2½ to 7 per cent iron sulfide, ½ to 1¼ per cent calcium carbonate, and sufficient asphalt to make 12 to 14 per cent by weight asphalt is added to the asphaltic sand rock. The mixture is subjected to a high temperature to give a paving composition which is stated to be tough, elastic, and waterproof.

Pavement Composition in Which Sulphur Is Incorporated—A pavement composition in which sulfur is incorporated has been described by R. F. Bacon and I. Bencowitz (13). A typical composition for a base course has the ingredients:

Gravel or crushed rock	150 parts by weight
Sand	110 parts by weight
Sulfur-asphalt mixture	30 parts by weight

A typical composition for a surface course contains the materials:

Sand	110 parts by weight
Lime	17 parts by weight
Asphalt	17 parts by weight
Sulfur	17 parts by weight

The asphalt and sulfur in the two mixtures are preferable mixed such that the sulfur is added to the hot molten asphalt with strong stirring at a temperature above the melting point of the sulfur but not higher than about 160°C. Bacon and Bencowitz are of the opinion that no reaction between the sulfur and asphalt takes place under these conditions, and that a homogeneous product is formed which has a lowered temperature susceptibility without increased brittleness. The properties of the pavement surface with the above composition is made harder and more skid resistant by applying heat to the surface to cause a slight burning, thereby inducing a chemical reaction between the sulfur and asphalt. This heating also brings small particles of the aggregate in the mix to the surface, which also induces greater skid resistance. The production of a bituminous pavement by the Bacon and Bencowitz method essentially comprises the incorporation of a plastic sulfur-asphalt mixture with aggregate, and the heating of the exposed sulfur-asphalt-aggregate pavement surface by burning.

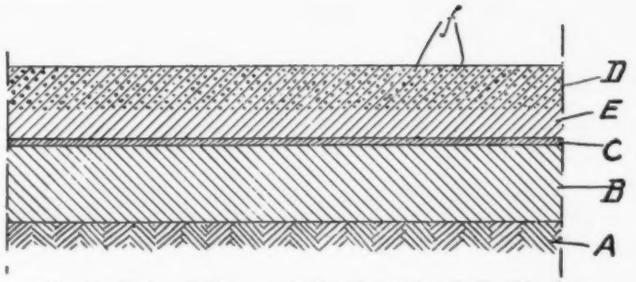

Fig. 7—Type of Pavement Developed by J. B. Warden
A. Foundation. B. and E. Soil Aggregates Mixture. C. Thin Layer of Deliquescent Salt. D. Bituminous Stabilized Mixture. E. Finely Divided Particles of Bituminous Construction

Pavement Composition—J. M. Johnson (14) has patented a pavement composition in which aluminum oleate, red oil, and a light lubricating oil is incorporated with aggregate and bituminous material. To prepare this pavement composition, the aluminum oleate is mixed with an excess of red oil and then mixed with twice its weight of light lubricating oil and heated to 150°F. to dissolve the soap. This mixture can either be added to the aggregate before the latter is coated with bitumen or be admixed with the bituminous material before the latter is applied to the aggregate. Other water insoluble soaps may be used in place of the aluminum oleate. The purpose of this type of admixture is to increase the adhesion between aggregate and binder.

Treatment of Siliceous Aggregate—The treatment of siliceous aggregate, prior to coating with bitumen, by substances to form a water insoluble soap film is the basis of a process used by A.B.C. Dahlberg (15). Aggregate of acidic character is first treated with basic substances, such as calcium, aluminum or magnesium compounds capable of:

(a) reacting with mineral surfaces, to form example, calcium silicate if lime is used
(b) reacting with saponifiable substances, such as oleic acid, to form water insoluble soaps.

The basic material may be added as a powder, solution or suspension. Next a saponifiable material is added as a

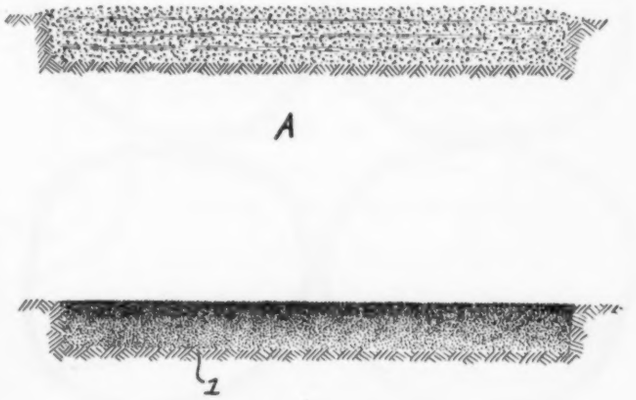

Fig. 8—Pavement Construction Methods of H. A. Ingalls
A. Condition of the Pre-Moistened Soil in Which the Oil Is Stratified Prior to Compaction. B. Condition after Compaction

solution in an organic solvent or as an emulsion in water. Fatty acids, glycerides, and resins may be used as the saponifiable material. In the construction of a bituminous pavement, the road surface of aggregate is mixed with the basic substance such as lime powder or lime milk. After some time, 15 minutes to a day, the road surface is sprinkled with a solution of a fat, ester or resin. This may be mixed by means of a road planer or other suitable equipment. The bitumen is added either in a molten state or in solution. It is claimed that the process gives a pavement impervious to water and that this process of aggregate treatment can be carried out in damp or rainy weather and even in water.

Paving Compositions—Mixing bitumen and aggregate in the presence of certain organic derivatives of amines has been found by H. Dohse and F. Spoun (16) to give more water resistant paving compositions. The type of organic substances specified by Dohse and Spoun are organic derivatives of ammonia containing at least one lipophilic radicle in the molecule. Analogous compounds derived from phosphorous, arsenic, antimony, or sulfur may be used. Ammonia, NH_3, itself has no action, but if one of the hydrogens in the ammonia is substituted by a lipophilic radicle, adherence of binder to aggregate is improved. Better results are obtained if more than one hydrogen is substituted by organic radicles with one at least preferably being a lipophilic group. The lipophilic group of concern here is the aliphatic fatty acid type of radicle. These organic addition agents may be added to the non-coated aggregate, to the aggregate as it is being coated, or to the bitumen prior to coating of the aggregate. In the use of these addition agents, it is possible to use emulsified bituminous binders, and mixing of bitumen, addition agents, and aggregate may be done in wet weather. The addition agents proposed by Dohse and Spoun lower the surface tension between the bitumen and aggregate in the presence of water and consequently induce wetting by the bitumen. The addition agents are cation-active and may give exchange reactions in the presence of minerals containing calcium, magnesium or the like. These addition agents in quantities less than one per cent give desired improvement in adhesion of bitumen to aggregate.

Stiffening Road Tars—C. A. Agthe (17) has added a condensation product to road tars to stiffen the latter in a pavement mixture. The process is applicable to road tars of sufficient fluidity to be applied at atmospheric temperature but which ordinarily would evaporate or thicken too slowly in the pavement. It can be used with viscous tars wihch do not have to be heated to a very high temperature to be sufficiently fluid for application, thereby eliminating the use of extreme temperatures in mixing. Thus, hard tars which are brittle can be substituted by a viscous tar to which the condensation product has been added. The condensation product is formed by the reaction of an aldehyde, such as formaldehyde, with a pine wood pitch, and is added in the powder form or in solution. The condensation product can be added in quantities approximating one per cent of the final mix.

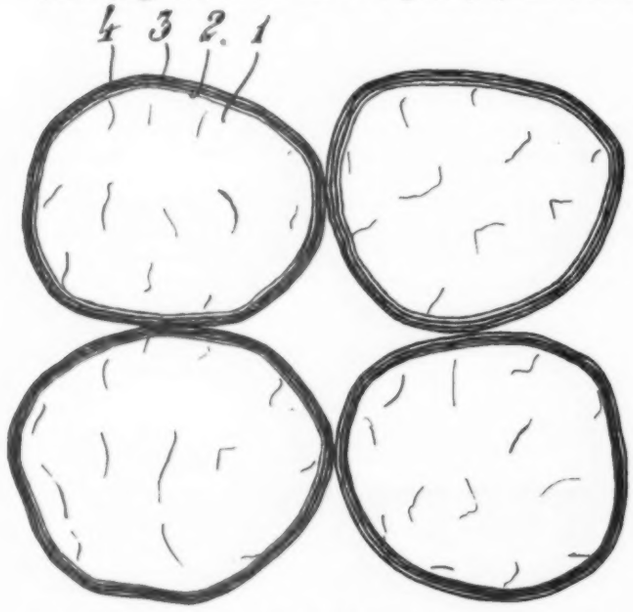

Fig. 9—Method of A. B. C. Dahlberg for Coating Aggregate
1. Aggregate Pieces To Be Coated. 2. Thin Layer of Basic Metallic Compound Capable of Chemically Attaching the Surfaces of the Pieces. 3. Thin Film of a Saponifiable Substance. 4. Layer of Bituminous Substance

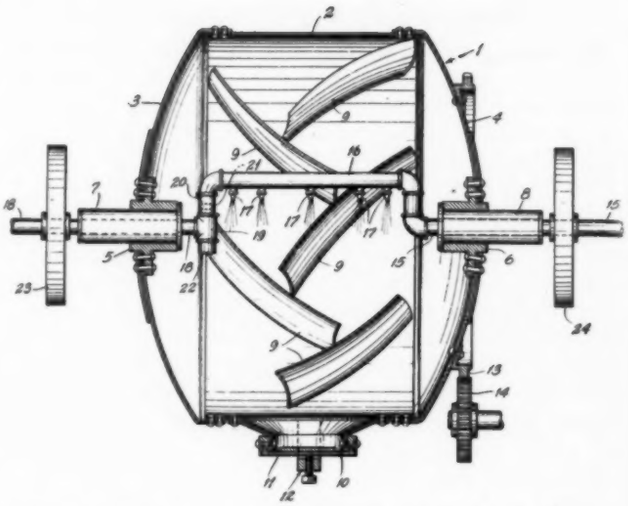

Fig. 10—Mechanism of J. G. Fuller for Making Paving Mixtures

Asphalt Planks—Asphalt planks for road surfacing have been developed by H. W. Greider and H. Marc (18) which withstand extreme temperature conditions and which are hard and tough without being excessively brittle. One of the essential factors in preparing the asphalt planks is the increase in softening point without correspondingly raising the brittle point. This is done by adding very finely divided solid material in the form of flour. A suitable proportion of coarse granular material is also added to the asphalt to increase resistance to flow under pressure. Fiber is incorporated to increase resistance to impact and compression. Greider and Marc found it preferable to use a mixture having the composition:

- 35-50% asphalt (R. and B. soft. pt. 165-185°F. and peneration of 15-3).
- 20-40% finely divided filler (slate flour, limestone flour, talc, etc.).
- 20-30% coarse material (material graded from No. 20 to No. 200 screen.
- 5-20% fibrous material (cellulose fiber or asbestos fiber).

Mixing of the materials is preferably done at about 325°F. The fiber and part of the filler is mixed with heated asphalt until completely coated. The remainder of the filler is added and mixing is continued until the mass separates into balls having dust-like coatings. The mass while still in a plastic condition is passed through an extrusion die.

Making Paving Compositions—A method of preparing paving compositions has been dscribed by J. G. Fuller (19). This consists of the steps:

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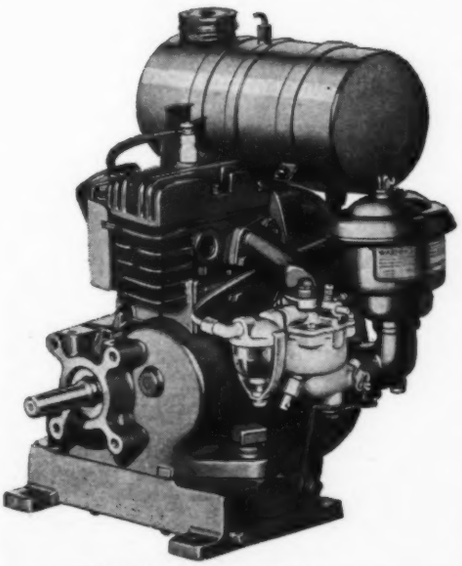

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(a) placing preheated aggregate in a rotary drum.
(b) displacing the air in the rotary drum by a non-oxidizing gas.
(c) Spraying bitumen into the drum.

The rotary drum contains several blades to facilitate mixing. The non-oxidizing gas is preferably superheated steam, the temperature of which may range from about 550°F. to 750°F. The steam pressure may range from 60 to 125 lb. pressure. The bitumen is forced into the pores and crevices of the aggregate particles, and since a non-oxidizing gas is used, the penetration and ductility of the bitumen are not altered by the conditions of this type of hot mixing procedure. The time required for mixing one batch is estimated to be about 5 minutes, and the temperature of the mix when removed from the drum will approximate 300°F.

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RECOGNIZED VARIETIES OF PAVING BRICK

At the annual meeting of the Permanent Committee of Simplification on Varieties and Sizes of Vitrified Paving Brick it was voted unanimously to propose to the industry the addition of the 4x3½x8½ inch wire cut lug brick to the list of recognized varieties because of its increased use in the city street pavements in certain localities. The addition of this brick increases the list of varieties satisfying 90.7 per cent of the total normal demand for vitrified paving brick. The recognized standards as adopted by the committee are as follows:

		Per Cent
Repressed lug	4 x3½x8½	9.5
Vertical fiber lug	2½x4 x8½	5.1
Vertical fiber lug	3 x4 x8½	54.4
Vertical fiber lug	3½x4 x8½	9.6
Wire cut lug	4 x3½x8½	12.1

There was a general discussion concerning the advisability of eliminating the 2½x4x8½ vertical fiber lug brick which decreased in shipments from 15.2 per cent in 1938 to 5.1 per cent in 1939. However, it was decided that this variety would be included until next year at which time it would be determined by the committee's working principle or formula whether it would be continued or dropped from the recognized group.

POST HOLES PUNCHED BY PAVEMENT BREAKER

H. R. Miller, road contractor of Lancaster, Penn., who has used his Novo pavement breaker on several concrete breaking jobs, has had it rigged up to punch out post holes for guard rails. The post hole punching device was fastened to the 2,700-lb. hammer of the breaker in place of the usual blunt nose used for the average breaking or the cutting knife used for trench work. The punch was made up of extra heavy 10-in. pipe with a reinforced point.

The breaker, so equipped, punched out guard rail holes at the rate of 200 per day. Thi swas quite a remarkable performance when considering the fact that a large part of the work was through a back-fill containing very large rocks and stones.

Breaker Hammer Equipped with Post Hole Punch as It Strikes the First Blow

Third Blow Where Punch Is Driven into the Hilt and Post Hole Is Dug

For the most part these holes were punched out with only three blows of the hammer. The first blow entered the grade a foot or so. The second went over half way in, and the third drove the punch in full length. Then the machine was moved to the next position.

The R. D. Baker Co. of Detroit, Mich., equipped a Novo breaker with an especially long cutting knife on the hammer and used it to cut through frost last winter on a ditch job, thus making a substantial saving.

Public Works Congress—The 46th annual conference of the American Public Works Association will be held Sept. 30, Oct. 1 and 2 at the Book-Cadillac Hotel, Detroit, Mich.

A $2,400,000 Ohio Highway Letting—Bids were opened July 26 and 27 by the Ohio State Highway Department on 24 projects, estimated to cost $2,445,492. The largest project calls for the construction of 5 miles of 22 ft. concrete pavement on U. S. 40. The work includes 635,266 cu. yds. of excavation. The estimated cost is $717,500.

World's Longest Dam—Construction is now under way in South Carolina on what will be the world's longest dam. This is the Santee Dam, a part of the Santee-Cooper Hydroelectric and Navigation project which is being financed by the Public Works Administration. The structure will be approximately 8 miles in length, consisting of a concrete spillway section 3,400 ft. long, with earth fill dams on each side. The project is now a third finished. It will be completed by the end of 1941.

Latest News on the Washington National Airport—

Above: 'Dozing the fill material. An unusual rock formation from the river bed makes it tough on tracks, but the TD-18's are standing the punishment in good shape.

Left: One of the International I-40 Wheel Tractors pulling a heavy-duty cultivator, mixing gravel on a runway.

The Airport Story of the Year:

Internationals win at Washington!

Runways are rough-formed by the TD-18's which also mix the surface with plows, cultivators, and harrows.

24 International TD-18's are Speeding it to Completion!

AMERICA'S largest airport and terminal, at Gravelly Point, Va., serving the nation's capital, is now being rushed to completion with the aid of 24 International TD-18 Diesel TracTracTors. These powerful crawlers have taken over this tremendous earth-moving job as a result of the outstanding performance of one of these units which went on the job a year ago.

When the new TD-18 hit the market early last year, the demand far exceeded the supply. As soon as the Northern Virginia Construction Co., Alexandria, managed to get one, they put it to work on the Washington Airport. Right from the start, the TD-18 became the most popular tractor on the field. Everyone wanted to use it. Unqualified statements made by those who got it, labeled the TD-18 as the *best tractor on the field regardless of size.*

With all these men *the reputation of* this great tractor *was made.* It was natural, then, for 12 more TD-18's to get the call in February. Today there's a total of 24, owned by the Northern Virginia Construction Co.; L. B. Smith, Harrisburg; and the Capital Excavating Co., Highway Engineering Co., and Morauer and Harzell, Washington. In addition, there are 2 International I-40 wheel-type tractors on the job.

There are many reasons back of the amazing success of the International TD-18 Diesel. *It had to be plenty good on the Washington Airport*—as on *every* job, because it's been under the severest scrutiny. Wherever it works it comes through with flying colors. It *has everything* crawler-tractor users have wanted for years. And its three new smaller brothers are also carrying on the good work. For complete information on these four International Diesel TracTracTors, see the International industrial power dealer or Company branch near you.

INTERNATIONAL HARVESTER COMPANY
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180 North Michigan Avenue Chicago, Illinois

Four TD-18's working on a section of the field. Fleets work in conjunction like this, handling the wet and dry fill.

INTERNATIONAL Industrial Power

COMPACTION OF EARTHWORK

Specifications, Testing and Contruction Methods on Two Road Sections in Kansas

By E. L. SEIDEL
Resident Engineer, Kansas State Highway Commission

THE earthwork on this project on U. S. 36 in Doniphan County, Kansas, was divided in two sections, and the contracts for its construction were awarded to different contractors. The sections were designed as Section A and Section C, and as the equipment and methods of construction were different on each section, I will describe the specifications and methods of testing which were the same on both sections and then take up the construction of each project separately.

Kansas Standard Compaction Test

A soils survey had been made on this project prior to construction, and compaction studies of each type of soil had been made to determine the standard compaction of each type of soil, and minimum moisture cotnent at which each type of soil could be rolled. The standard compaction test as described by the Kansas Highway specifications, is designed to determine the moisture content at which maximum compaction is obtained, and to determine the density (dry weight per unit volume) which is obtained at that moisture content when a soil is compacted in three layers in a mold, 4 in. in diameter and having a volume of approximately one-thirtieth cubic foot, by applying 25 blows on each layer by means of a specially constructed hammer having a 2 in. diameter face, and delivering a blow to the soil approximately equivalent to that of the drop of a 5½ lb. hammer through a space of 18 in. The maximum density obtained in this test is designated as the standard compaction of a soil. Figure 1 is an example of the compaction curve of one of the soils on Section A. The specifications on this project called for Kansas Highway Commission's Type "C" compaction. Type "C" compaction specifies that each successive lift or layer of soil shall be compacted to a density equal to or greater than 90 per cent of standard compaction, and that no lift or layer shall exceed 6 in. of compacted soil, and that the moisture content shall be limited only to that which will insure the density specified under the compaction requirements.

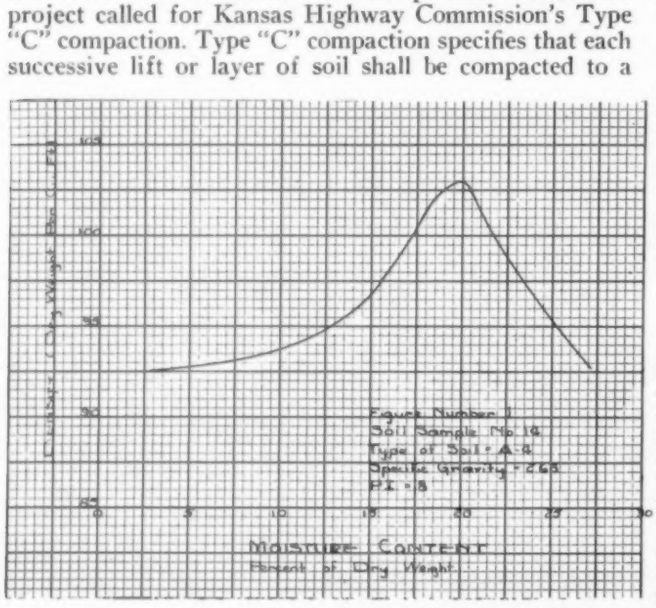

Fig. 1—Example of Compaction Curve on One of the Soils of Section A

Fig. 2—Illustrating How Readily the Soil on Section A in the Wolf River Valley Took Water and Became Unstable. This Section Was Topped Out with Selected Borrow Material

Requirements for Sheepsfoot Rollers

Sheepsfoot rollers were used on this project. Their requirements were that they be metal rollers, drums or shells, surmounted by metal studs with tamping feet projecting not less than 7 in. form the surface of the roller, drum or shell. Tamping feet shall be spaced not less than 6 in., measured from center to center in any direction, and the cross-sectional area of each tamper foot measured perpendicularly to the axis of the stud, shall not be less than 4 or more than 12 sq. in. The weight of tamping rollers shall be such that when fully loaded, the load on each tamper foot shall be not less than 95 lb. per square inch of cross-sectional area.

The rollers used by the contractors on both these sections, had a weight on the tamping feet between 175 and 200 lb. per square inch.

Compaction Tests

A rolling and tamping inspector was kept on the project by the highway commission at all times while the contractor was working. Compaction tests were run on the fills for at least every 500 yds. moved by the contractor. As a rule four tests were run for each eight hours worked by the contractor. Of course these tests sometimes would cover much less than 500 yd. Samples were dug out of the fill with a tile spade, by digging around the sample and then breaking it loose. This sample was then trimmed to a 4 or 5 in. diameter for the thickness of the lift. This trimmed sample was then weighted and immersed in kerosene until it ceased to bubble, then taken out and blotted with a dry cloth. The

Fig. 3—Elevating Grader Loading Trac-Trucks on Section A

volume of the sample was determined by measuring its displacement when placed in an overflow volumeter filled with kerosene. About 1,000 grams of the material trimmed from the sample was then dried over a gasoline stove to determine its moisture content. Using the moisture and the weight of the sample, the dry weight of the sample was figured. From the dry weight and volume, the density, or dry weight per unit volume was figured.

General Features of Section A

The net length of Section A was 2.335 miles and it contained 192,530 cu. yd. of excavation. This section was built through the Wolf River Valley, and was new location. There was only one center line cut on this project. This contained approximately 24,000 cu. yd. The rest of the material came from borrow pits and channel changes. The soil in the valley and in the channel changes was a dark brown soilty clay loam with a P.I. of 12 to 17. It was possible to roll this soil but it took moisture very readily and then became unstable. The soil on top of the adjacent hills was a brown silty loam or Loess Type of soil. This soil, while very similar to the soil in the valley, had a P.I. of 8 and did not take water very readily. The top 2½ ft. of this section was topped out with material from two borrow pits that were located on top of the hills. These pits were located 570 ft. and 350 ft. from the center line. The first pit had an average haul either way on center line of 1,500 ft. and the second an average of 1,800 ft. The location of these pits made the haul very long on this project.

The contractors used two different types of excavating equipment on this section. On the channel change excavation a 1¾ yd. drag line was used, and for hauling equipment, 8-yd. tractor wagons pulled in tandem by a 65 Caterpillar tractor. The hauls were not so long on the channel material and three of the above units were used.

On the pit excavation a 48 in. elevating grader pulled by a 70 Caterpillar tractor was used. For hauling, five Euclid Trac Trucks and from one to four Hug trucks, depending on the length of the haul were used. For keeping the fill level a cable controlled bull-dozer mounted on an RD 6 Caterpillar tractor was used. 12 ft. blade pulled by a 50 diesel tractor was kept on the job at all times, and if needed, was used on the fills; if not used on the fills, it was used on the shoulders or in the pit.

When there was plenty of moisture in the material it was placed in a 7 to 8 in. lift which compacted down to about 5 in. When the moisture in the material would drop down too far on the dry side of the compaction curve, it was found necessary to place the material in much lighter lifts or the roller would have to make too many passes to get compaction. The contractor used for rolling, a double drum sheepsfoot roller pulled by an RD 4 Caterpillar tractor.

General Features of Section C

The net length of Section C was 3.374 miles and it contained 361,800 cu. yd. of excavation. This section, outside of the re-location of several curves, was all built on the old center line. This location was through very rolling country and the excavation was all center line cut. The material from the cuts on top of the hills was the same type of material that was used for topping on Section A.

The contractor used for excavating and hauling equipment on this section two U 20 Le Tourneau Carry-alls. These were pulled by D 8 Caterpillars and pushed in loading by a Model L Allis Chalmers tractor with a hydraulic bull-dozer. A short section of the curved blade on the bull-dozer was filled out with a steel faced wooden block to make its face square so that it could be used as a pusher. After the project was started the contractor added to his equipment, one 12 yd. Le Tourneau Carry-all and D 8 Caterpillar tractor, and one 12 yd. hydraulic controlled Austin Western scraper, pulled by a Caterpillar 75 diesel tractor.

The contractor thought that he would be able to keep his fills level with his U 20 carry-alls, but since he had only two carry-alls at this time, it was cutting down his yardage to use the carry-alls as a blade. It was necessary for him to add a 12 ft. blade pulled by a Model L Allis Chalmers tractor to his equipment. The contractor tried to use two double drum sheepsfoot rollers pulled in tandem by a Model L tractor for rolling equipment. It was found, since the fills were all rather short to start with and a lot of turning necessary, that it took too long a space and too much time to turn the tandem outfit around, and that more rolling could be done with a single double drum sheepsfoot pulled by a Model K Allis Chalmers tractor.

No particular trouble was encountered in rolling on this section except that one of the cuts was rather deep, and a stratum of wet material was encountered which had too much moisture to roll. The contractor would dry this material in the cut by cutting deep furrows with a blade and then letting the cut set for a day.

The contractor on Section A was the Mike Haase Construction Co., of Kansas City, Mo., and the contractor on Section C was the H. J. Hall Construction Co., of Manhattan, Kans. Work was started on both of these sections in October of 1938 and completed in August of 1939.

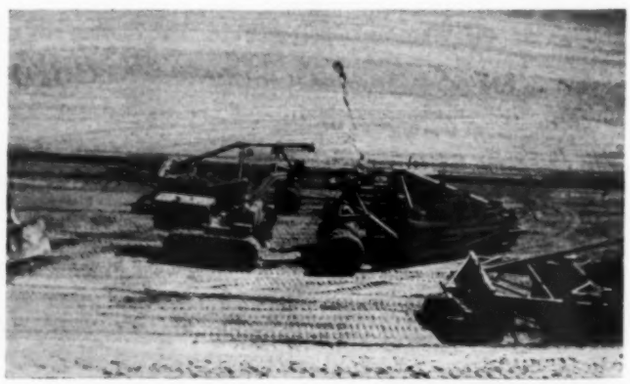

Fig. 4—Carry-Alls Working on Section C, 12 Yard Carry-All Loading Itself, a U 20 Carry-All Loaded, with the Pusher in the Left of the Picture Coming Up to Push the U 20 That Is Loading in the Right of the Picture

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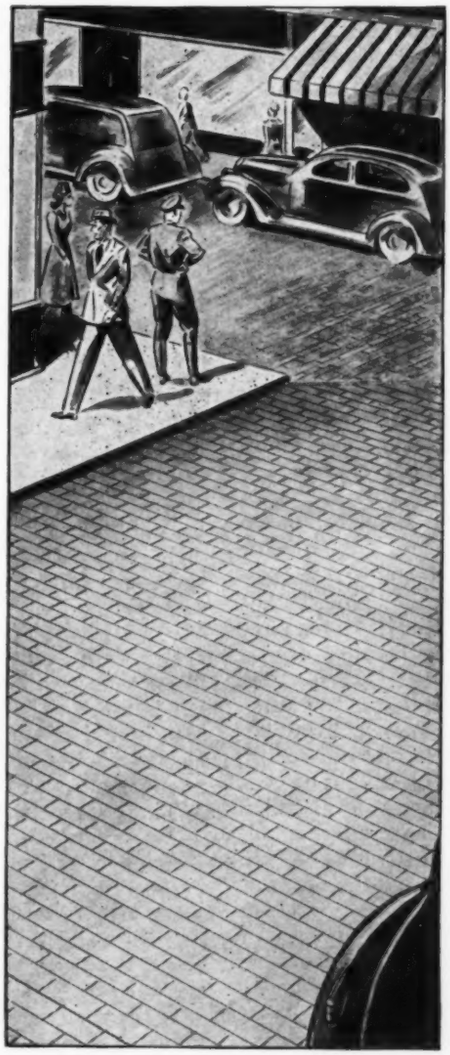

Whether you are paving a trunk-line highway or an obscure residential street, it is true economy to use brick.

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Brick has been made and used for more than 50 centuries. Yet in only the last decade many improvements have been made in its manufacture. And in the technique of using brick in pavements, more progress has been made than in all the years before!

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BRICK

FOR NEW AND RESURFACE JOBS

THE MULTIPLE-PHENOMENA METHOD OF RESEARCH

By HALBERT P. GILLETTE

"True ease in writing comes from art, not chance,
As those dance best who've learned to dance."

POPE'S advice is applicable to every class of brain-worker, but it should be amplified. Practice alone does not make perfect. Perfection in science (or rather that approach toward it that we arbitrarily call perfection) is attained only through knowledge of natural laws, correct interpretation of them and effective methods of applying them. This is as true of scientific research as of designing an economic bridge, although not many researchers seem to realize it. On every hand we see men essaying to become researchers without much previous study of the methods used in successful research. They are almost on all fours with would-be authors who flood the magazines with stories of no merit.

Any attempt to discover a natural law or principle is praiseworthy, and its issue may be successful; but the number of successes would be vastly greater were such attempts preceded by a research on research. The ancient Greeks occasionally discovered a scientific law. The rareness of such discoveries clearly shows that they lacked not brains but sufficient understanding of effective methods of research. Whewell and others before him have pointed out that the Greeks failed to appreciate the need of interrogating Nature by experimentation. True, but only partly true; for blind experimentation usually results in no great harvest.

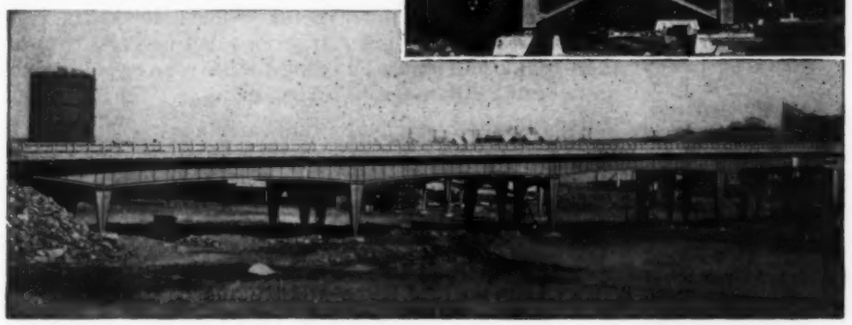
The most effective of all methods of research has been the use of analogical reasoning. Yet logicians have usually decried that type of reasoning because of uncertainty as to its correctness! Granted that it often leads to error, still it remains the only way by which the secrets of Nature can be devined merely by thinking. What the Greeks failed to see was that deductions from a tentative theory should always be put to test by facts found by experiment or observation. What modern researchers in observational science have usually failed to see is that the most generally applicable criterion of the truth of a tentative theory is the one furnished by mathematical probability. By that test one can determine whether an alleged agreement between an inference from a theory and facts is accidental or not.

Some years ago the late Prof. T. C. Chamberlin, a celebrated American geologist, drew attention to a method of research that he called the multiple-hypothesis method. It involves testing systematically a number of hypothetical explanations of a given phenomenon by appeal to facts. Its merit consists in guarding the researcher against prematurely regarding some pet theory as offering a correct explanation. Its defect is that it is apt to lead a researcher to abandon, too soon, a sound hypothesis because of the difficulty of proving it. Newton did not win fame by having multiple hypotheses as to orbital motions. He adopted but one hypothetical cause, gravitation, and he clung tenaciously to that one. So did Kepler before him; for while he tested many curves before he found that the ellipse fits the facts best, he had but one basic hypothesis as to planetary motion. It was what today may be called the Geometricity of Nature. He regarded it as consequent upon a geometrical proclivity of the Creator's mind.

Half the space alloted to this article has been spent in introductory comments. But there is left enough to outline a method of research that I have found very effective in studying the cause of weather and climatic cycles. It may be termed the multiple-phenomena method. Instead of adopting multiple hypotheses of the cause of cycles, search was first made for a single hypothesis that seemed competent to account for several different types of correlated cyclic phenomena. The basic problem was to find the cause of cycles of the same length in rainfall, atmospheric pressure, earthquakes, sunspots, auroras, magnetism, earth currents, etc. Certain of these had been plausibly explained as causes of certain others. For example, earthquakes might possibly result from changes in air pressure over great areas. But, if so, why was there no known correlation between ocean tides and earthquakes? Tides cause greater changes in pressure than occur as a result of barometric changes. Sunspots had been correlated with very, very minute changes in solar heat entering the atmosphere, and this heat variation seemed a plausible explanation of at least a few weather cycles. But these changes in "the solar constant" are so slight that some investigators denied their reality. In any event the amplitudes of certain rain cycles are far too great to be satisfactorily explained by such tiny amplitudes in solar-constant cycles. One by one the alleged basic causes of weather and climatic cycles were examined and labelled doubtful. This seems like an application of the multiple-hypothesis method, but is not, for it led to a thorough examination of only one hypothesis. That hypothesis may be termed the electronic hypothesis of the cause of all correlated phenomena, weather being but one of these.

The next step was to gather data as to alleged correlations, both as to the lengths of cycles and the dates of their epochs of maxima and minima. No type of known cycle was omitted from this investigation. The data related to rainfall, air pressure, air temperature, wind intensity and direction, crops (quantities per acre and prices), tree-ring thickness, thickness of varves, thickness of rock-strata, fossil zones, geological periods, spacing of recessional moraines, lake levels, river floods, freezes, droughts, famines, migrations, sea-levels, rate of axial rotation of the earth, auroras, sunspots, eruptions, terrestrial magnetism, earth currents, electric-potential gradients, compass declination, dip of the magnetic needle, earthquakes, microseisms, volcanic eruptions, lava "tides," lake seiches, periodicity of sea waves, brilliance of comets, meteor-showers, orbital periods of planets, periods of variable stars, etc. Of the four last-named phenomena only one—orbital periods—might seem to be likely to throw light on the cause of weather cycles. But who can tell in advance that a given type of cyclic phenomenon is unrelated to some other type?

Lincoln Tunnel Approach
. . . interesting example of Modern Grade Separation



Above—Plan view of Lincoln Tunnel Approach at North Bergen, N. J. Main highway (left) is a dual-roadway viaduct 1152 ft. long, carried on 4 lines of continuous plate girders. Separated by a plate and angle railing, each roadway is 32 ft. wide with 2 ft. 6 in. and 3 ft. 4 in. sidewalks. Circular ramp to Route No. 1 (background) is 610 ft. long, and ramp along Patterson Plank Road (foreground), 195 ft. long.

Center—Erecting the looping ramp from Route No. 1 to the main approach. Steel roadway deck, on grade, curve and super-elevated, is carried on 2 lines of longitudinal plate girders supported on braced bents.

Bottom—Part elevation of the main approach viaduct, which consists of 9 continuous, plate girder spans of varying lengths from 50 to 161 feet. Typical of the construction are the pleasing lines of the curved flange girders and rigid frame bents.

Built for The Port of New York Authority, J. C. Evans, Chf. Engr.

UNIQUE among today's grade separation projects is the Lincoln Tunnel Approach between State Highway Route No. 3 and Prospect Avenue at North Bergen, N. J.

Framed as a continuous, multiple span, deck plate girder structure, this intricate steel viaduct comprises a dual-roadway main unit overpassing existing highways and the Erie Railroad tracks, a looping ramp connection with Route No. 1, and a second exit ramp along Patterson Plank Road.

The main approach highway is divided, by means of a steel curb and railing, into two separate roadways, each independently framed with 2 lines of carrying girders supported on rigid frame portal bents. The two single-roadway ramps are similarly framed, though further complicated by grades, curvatures and super-elevations.

This interesting application involved some 1960 linear feet, and 5400 tons of exacting steel fabrication, and erection, all satisfactorily done — on time—by American Bridge Company.

AMERICAN BRIDGE COMPANY

General Offices: **Frick Building, Pittsburgh, Pa.**

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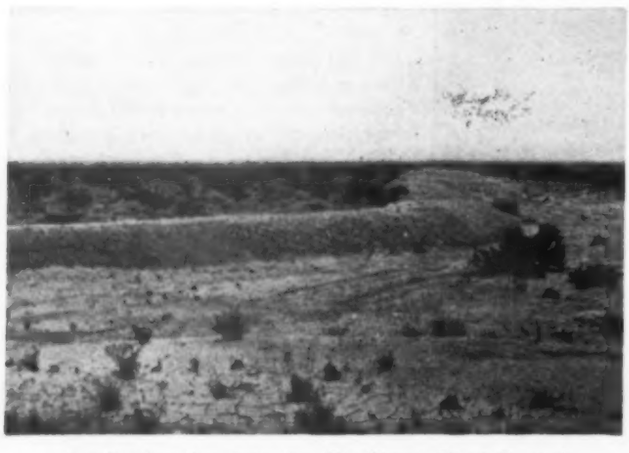
UNITED STATES STEEL

The fundamental unity of Nature has been acclaimed for generations. Yet, for the most part, only lip-service has been given to that doctrine. May it not be that there is a unity far more profound than has been suspected? And if so, what is there that seems capable of causing it? Electron theory has already revolutionized laboratory physics and chemistry. May it not revolutionize also the observational sciences? It has at least made a start toward that goal in astronomy via the spectroscope. Why, then, should researchers in astrophysics hesitate to regard the electron as being possibly an important factor in the movements of heavenly bodies—yes, in their very genesis? Why should geologists hesitate to infer that the great pulsations of the earth's crust, known as revolutions, may be regularly cyclic and caused by influxes of electrons? Defeat in previous attempts to explain those grand crustal pulsations is usually conceded, yet congenital skepticism raises its hand against the electron as King Canute did against the ocean. The tide of electron theory refuses to ebb. On the contrary it bids fair to overflow every branch of science. Of all phenomena only one type seems competent to explain the acclaimed unity of Nature, namely the electronic type. If you doubt it, read such a book as Richardson's "Electron Theory of Matter."

PREVENTING WASHOUTS

THAT section of U. S. Highway 95 between Las Vegas, Nevada and the Charleston Park turnoff, about 35 miles north, lies in an area which experiences sudden and heavy rainfalls of cloudburst proportions. These land squalls don't last very long but rain comes down in sheets while the storm is in progress and because of the flat terrain, with long gradual dips, water frequently rolls down its stream course in walls of water 2 and 3 ft. deep. This never fails to produce trouble for the section of the highway which lies in the path of the rushing waters. Wherever the highway dips slightly from the vertical there is created a favorable spot for this sudden and heavy run-off to concentrate and wash over the highway with disastrous results. Small pipe culverts control normal drainage but these are inadequate to take care of the large quantities of water which fall on the higher ground.

Along one particular stretch of 10 miles in this area the drainage fall is along the upper side of the highway and when these cloudbursts come the water wall rushes



Small Diversion Dyke for Cloudburst Flood Control

Section of Dyke and Culvert Entrance

down its grade washing out shoulders, filling culverts and running over and down the surface of the road in many places. This interferes with traffic and also creates a menace to moving vehicles. It becomes dangerous when traffic gets caught in the rapid current of these swollen dry streams. Cars are sometimes damaged and occupants injured.

Maintenance men in the Las Vegas division believe they have found a solution of this problem. Treatment consists in building grouted rock overflow sections at the upper end to carry off some of the flash run. Grouted rock-based dykes have been constructed at each culvert which retards the speed of the flow. These dykes are built coping high and in such a manner that each culvert is permitted to carry its full capacity, in each pipe. Surplus water flowing against the culvert is backed around the dyke into a roadside ditch then guided down the hill to the next culvert, where the process is repeated.

In some instances ditches have been constructed to take surplus waters away from the culvert and into the flat areas where appreciable quantities of water will be absorbed by the ground or be taken by evaporation. In other places where the culvert does not function to capacity because of the small flow line, ditches have been constructed some distances from the roadway to bring more water toward the structure—this relieves the load. The system was designed to force small culverts to carry their maximum loads, allowing the surplus to be diverted and eliminate damage to the roadway.

This method of cloudburst water control has proven very satisfactory and has done away with one of the most troublesome difficulties in Nevada Highway Department's Division Number One in the Las Vegas area.

J. M. Murphy is the Division engineer, under State Highway Engineer Robert A. Allen, whose headquarters are at Carson City.

"THEY SHALL NOT PASS" WITHOUT PAYING TOLL

The State of West Virginia has finally received $83.45 from the Federal Government. This sum was withheld from the forestry road allocations of the state as a result of a dispute over toll charges assessed against an army detachment in 1938. The dispute arose when toll bridge operators on the Parkersburg-Belpre Bridge assessed an army detachment from Fort Bragg, North Carolina, the sum of $83.45 in September, 1938, before permitting the troops and equipment to cross the bridge.

SPECIAL LATHE FOR SHARPENING PLANER DISCS

A special lathe built in the Nevada Department of Highways Equipment shop, located between Reno and Sparks, on U. S. 40, is used for sharpening discs.

The lathe is powered by a 3 HP electric motor driving first through a two speed of a discarded Ford truck transmission, then to a worm gear (ratio 50 to 1), of a discarded Right-way Snogo unit, then through a 4 to 1 gear reduction straight through the gear to the main arbor of the lathe. The lathe has a speed of 4½ r.p.m. in low gear and 8 r.p.m. in high gear.

A rotor unit hub is used for the main arbor. A special shaft was made with the reduction gear on one end and

Disc Sharpening Machine in Reno-Sparks Equipment Shop

an extension 12 in. by 2¼ in. square on the other end to drive the discs and the three castings. By using a draw nut on the three castings and the discs it is possible to straighten any discs that are worn and thus avoid turning any extra amount of metal in order to get a good, sharp cutting edge. The heavy castings prevent tool chatter.

Sharpening costs have been cut better than 50 per cent in labor alone, and in addition the very considerable cost of replacing broken grinding stones has been eliminated.

▼

Annual Meeting Highway Research Board—The 20th annual meeting of the Highway Research Board will be held Dec. 4 to 6, 1940, at the building of the National Academy of Sciences and the National Research Council, Washington, D. C. The first two days of the week, Dec. 2 and 3, will be devoted to meetings of the various committees and departments, many of which will be open to the public. The annual dinner will be held Thursday evening, Dec. 5.

COUNTY BRIDGE MAINTENANCE

How Kent County, Michigan, Employs Arc Welding on Its Highway Structures

By L. W. BRUNSON

Bridge Engineer,
Kent County Road Commission, Michigan

THE bridges of the road system of Kent County, Michigan, are fairly numerous but none of them are very large. They vary in length from 15 ft. to 600 ft., and the total number is 250. Placed end to end their total length of spans would extend a distance of slightly more than two miles. Quite a large percentage of them are aged and infirm, the maximum age being 77 years, while about 40 per cent are either very narrow or incapable of carrying legal loading, or both.

This bridge system, along with the 2,000 miles of county roads, is administered by the county road commission consisting of three members, heading an administrative staff of engineers and other employees totaling about 250. Otto S. Hess is the engineer-manager.

The policy of the commission with regard to bridges is to repair, strengthen and replace those under the minimum standard as rapidly as possible. The total amount spent each year for maintaining, repairing, strengthening, and replacing the aged, narrow and infirm structures averages close to $50,000.

Probably the salient feature of our more recent bridge program has been the consistent use of large quantities of structural steel, and the employment of arc welding almost exclusively to hold it together. So far as I can remember, we have not used a bolt or a rivet in the last five years, except to bolt wood parts together or to other steel members.

Conditions Requiring Repairs

Practically all our longer bridges are of the through-truss type and a large percentage are upwards of 35 years of age. Most of them were not designed for modern loads and they have had to be revamped, strengthened and repaired. With a few exceptions, the steel trusses have been found adequate for modern loads, providing they were equipped with lightweight decks. Many had weak floor beams which were strengthened by welding on cover plates and in some cases stiffener plates. A few had weak hip-verticals, which were either replaced or strengthened by welding on additional metal. A few riveted trusses had lower chord angles which were badly corroded and therefore weak. These were replaced by flame cutting rivet heads and driving out the rivets in one-half of the member and then welding in a new angle; then repeating this operation on the other half. Many of the pin connected trusses had one or more diagonals in which the two bars were not of the same length when constructed. This left the longer bar loose and unable to take its share of the load. These had to be flame cut and butt welded to take up the slack, after which the splice was strengthened with flat bars fillet welded in place.

Fig. 1.—Bridge over Rogue River near Grand Rapids, Repaired by welding

Fig. 2.—Bridge Shown in Fig. 1 after Dismantling

Lightweight floors have been constructed largely of steel stringers topped with creosote-treated wood plank and a wearing course of asphalt plank. On light traffic roads our lightweight bridge deck surfacing has been white oak plank, selected to rigid specifications and dressed to uniform thickness without wearing surface.

The accompanying illustrations and descriptions are more or less typical of the bridge work which has been and is being done by this organization, in an attempt to correct the faults and infirmities of the bridges on the county road system. Practically all of the bridge work done during the past ten years has been carried out by county forces under the direction of its engineering staff. We have one special bridge crew which works on the larger jobs the year around. At times a second crew has been organized for a few months. Some of the smaller jobs have been done by the road maintenance crews along with their regular work.

Fig. 3.—Strengthening Floor Beams by Welding in New H-members

Strengthening and Repair of Old Truss Bridge

This bridge is over Rogue River, about ten miles north of Grand Rapids. The bridge has a total span of 90 ft.; roadway, 14 ft., and clear height of about 12 ft. above stream bed.

Figure 1 shows the structure before repairs were made. It was in such condition that it had to either be replaced or repaired and strengthened very extensively. A new structure with a wider roadway was estimated to cost $15,000 which was deemed excessive, considering the small amount of traffic to be handled. After careful analysis, it was decided to repair and strengthen the old bridge as follows:

1. Remove and replace north abutment.
2. Remove and replace approach span at north (left) end.
3. Remove and replace truss stringers and floor.
4. Replace concrete wings on south abutment, one of which had fallen over and the other was trying to follow suit.
5. Strengthen truss floor beams.
6. Repair and strengthen pier by replacing floor beam and the placing of heavy bracing.
7. Place new channel rails on both truss and approach spans.
8. Trusses were O. K. for strength and condition.

Figure 2 shows the old bridge taken apart. The approach span and abutment at north end are gone, the old floor and stringers have been removed from the truss span. On the truss span and across the open water is a temporary cat-walk. At the south end is the housing inside of which is being constructed the new concrete wing-walls.

Buried Braces in Abutment—The new all-steel welded abutment, which replaced the old decrepit north abutment, is very similar to the abutments of the new double span bridge, (see Fig. 6), except that the wings are at a 45 degree angle and it is equipped with a buried system of braces which are designed to prevent tipping and shoving of the abutment. All of the parts are fastened together with arc welding, largely of the fillet variety.

Fig. 4.—I-Beam Stringers in Place Ready for Plank Floor

In Figure 3 can be seen floor-bears on the truss span receiving their strengthening, in the form of 4 in. x 4 in. H-beams. These floor-beams which are light plate girders were found to be quite badly deteriorated along the top flange and this type of strengthening provided a stiffer seat for floor stringers as well as the necessary added moment of inertia. The small H-beams shown were welded full length and across the ends with a continuous ¼-in. fillet weld. It might be of interest to note that in making long welds of this type we always insist on tacking at intervals of about 1 ft., such tacks being placed in the following sequence; ends, center, ¼ points, ⅛th points, 1/16th points, etc. We feel that this method helps to eliminate a portion of the internal stresses produced by unequal heating of the two adjacent members.

Figure 4 shows the steel I-beam stringers welded in place, ready to receive the plank floor. White oak plank dressed to a uniform thickness were fastened securely to the stringers with a series of cleats and double-pointed nails.

Fig. 5.—Bridge in Fig. 1 after Repair by Welding

A roadway view of the bridge after completion is shown in Fig. 5. Note that the new concrete backwall extends above the road level at the corners. These projections together with the steel plates fastened to the railing posts provides a protection to the truss and posts from flying gravel and dirt which would be deposited by our truck scrapers during road maintenance. The cost of these repairs and partial replacements was approximately $5,000 including engineering expense. We feel that this structure should be adequate to handle the traffic for 15 to 30 years and that the $10,000 saved was money well earned.

Constructing Modern "Bedstead Type" Bridge

The new bridge shown in Fig. 6 is over Rogue River in northwest part of Kent County, Michigan. It is a 45-ft. span, 22-ft. clear roadway and 8-ft. clear height above stream bed.

This bridge was constructed in 1937 and is a typical example of a number of structures which have been built by the Kent County Road Commission during the past few years. The basic design resembles very closely the old, well known "bedstead type" which has been in great favor by old-time bridge builders and township highway officials.

The "bedstead type" usually had abutments built of

I-beams resting on timber sills, and a layer of plank behind the I-beams to hold back the road fill. Across the top end of these vertical I-beams was bolted a steel channel which formed the seat for the steel floor stringers. A plank or concrete floor and light steel railings completed the job.

The modern version of the "bedstead type," as can be seen from Fig. 6, is more rugged and while built of steel up to the concrete deck, has all the appearance of a concrete bridge to the casual traveler. Each abutment is a row of steel H-beams driven to at least a 10-ton capacity and backed by three rows of steel angles welded to the piles with a continuous filet weld to seal off the adjacent surfaces. Hung from the upper angle are sheets of heavy corrugated galvanized pure iron which hold back the road fill. These corrugated sheets are fastened to the top angle by tack welding the points of contact. The steel piles are protected from corrosion at the water line by individual concrete encasements cast inside ordinary reinforced concrete culvert pipe. The lower edges of the corrugated sheets, which extend well below low water, are protected from distortion by earth pressure by being bolted to oak timbers resting against the pile encasements. The pier is a single row of H-beams piles braced with heavy angles welded in place. The water line protection is by individual concrete encasement three feet long, the same as the abutments.

Fig. 6.—Modern Version of Welded "Bedstead" Type Bridge

The bridge seats on this glorified "bedstead type" of bridge were originally constructed by flame cutting slots in the tops of all piles and fitting ordinary standard I-beams into these slots, each in one continuous piece. This process, of course, involved the slotting of the bottom flanges of these bridge seat beams to allow them to clear the pile webs. Welding of all available intersecting surfaces of the piles and beams with a heavy fillet completed the bridge seats.

Simplified Design—Later designs were simplified by using a standard channel for the abutment bridge seats which were welded against the stream face of the piles. This method saved time and expense.

The concrete deck and railings are supported by steel I-beam stringers, which in this case, are not coninuous. These I-beams are welded to all of the steel bridge seats with a ¼-in. fillet weld all around, which provides the necessary support for the top of the abutment piles. No provision for deck expansion is made, since it has been found by experience that the adjacent road fills are sufficiently elastic to keep stresses within working limits.

This type of bridge is particularly adaptable to locations where the subsoil is such that the conventional concrete abutment type would require piling for support. This particular project cost a total of $5,500 which included channel change and a small amount of work in raising, widening and graveling the approach fills.

Fig. 7.—Two Welded Ice Breakers

The bridge alone cost only $5,000. If we had constructed a single span on concrete abutments supported by timber piling, we would have had to spend upwards of $10,000 for the whole project. Not only would the bridge have been more expensive, but the approach fills would have been at least a foot higher due to the increased depth of beams.

Not only is this new type of bridge inexpensive to build but it is easily and economically widened. The wing piles being in line with the abutment piles makes them available as future abutment piles by simply splicing on the necessary lengths of H-beams, and then driving new wing piles at each corner. Even the corrugated metal sheets in the wings can be used over again in the new wings.

Arc Welded Ice Breakers

Figure 7 shows two ice breakers constructed to protect one of our bridges over the Grand River about eight miles northeast of Grand Rapids. This bridge is a 3-span steel truss structure with a total span of about 450 ft. The ice breakers are about 25-ft. high. They were constructed in 1934.

The foundation is a V-shaped double row of H-beam piles. These 8-in. x 8-in. H-beam piles are about 30 ft. long and were driven to refusal in the hard pan beneath the river bed. Water line protection consists of individual encasements of concrete inside ordinary reinforced concrete culvert pipes, 3 ft. long. After cutting off piles to the proper elevation, the transverse channels were laid on the piles and the outline of pile tops scribed on the under side of the channel. Slots were then cut through the webs of the channels, just large enough to allow the piles to pass through about ½ in. This allowed the placing of a heavy down-weld

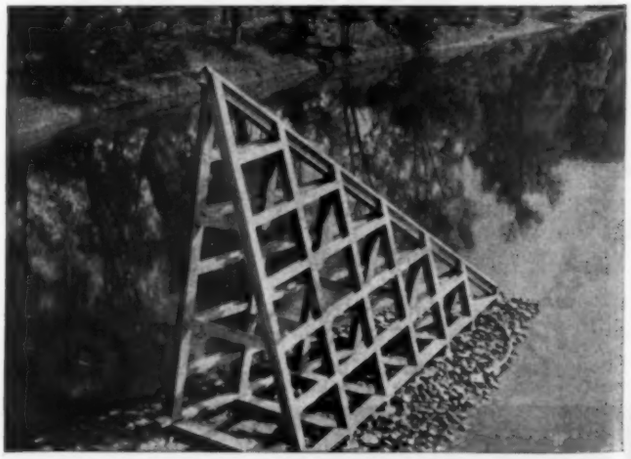


Fig. 8.—Close-up of Ice Breaker Showing Welded Construction Two Welded Ice Breakers

around the head of the pile. The foundation platform was completed by welding on two longitudinal channels in the form of a "V."

Figure 8 shows the super-structure in a little more detail. The sloping nose consists of an 8-in x 8-in. H-beam with a heavy angle welded full length to give it a cutting edge. The vertical side members are 8-in. x 8-in. H-beams and the horizontals are 6-in. x 8-in. H-beams. Interior braces are 6-in. x 6-in. H-beams. The vertical members are continuous, with no cuts at the joints. The external horizontals were cut so that their faces are flush with those of the verticals, and their webs and interior flanges left long enough to touch the webs of the vertical H-beams. Thus, when the various parts were butt-welded and fillet-welded together, they formed a continuous and very stiff framework.

It was originally intended to cover these frames with heavy plates, but this plan was discarded as unnecessary after completion of the first framework. Experience with ice fields during the subsequent years has shown that the plates are not only unnecessary but would have been a source of additional maintenance expense, providing a broad expanse of surface from which the ice could scrape the paint.

The slope of the nose is 1 on 1½. The usual ice level at break-up time is from 1/3 to ½ way up, on the ice breakers. When the ice starts to move, it shoves on the sloping nose which breaks out big pieces which fall at the sides. This becomes a continuous operation and the wedge shape of the ice breakers widens the broken path so that when the ice passes the piers, it rarely even touches them. Since installing these breakers in 1934, there have been no ice jams at this location. and the strain on the old, high and narrow piers has been removed entirely.

The total cost of these two ice breakers was approximately $4,000 which represents a large saving in cost over any other method of construction.

Our experience in repair of bridges by welding has led to our adoption of the electric arc process as the standard method. We find the electric arc simple to employ and extremely versatile in bridge work. The engine driven arc welder provides us a complete mobile bridge maintenance department. Modern shielded arc type electrodes and arc welders supplied by The Lincoln Electric Co., Cleveland, Ohio, are used.

EXPANSION JOINTS AT LONG SPACING

THE PROBLEMS of high joints, inside corner breaks and other ailments to which pavements at expansion joints are addicted, have been troublesome ones on many of the subgrade soils found in Kansas. Some of the proposed solutions now under trial are subgrade drainage at expansion joints, selection of subgrade soils and reduction of the number of expansion joints, by longer spacing. Each method has both good and bad features and because of the great variety of subgrade conditions found in Kansas, it is quite possible that the final solution lies in choosing one method or combining features of more than one method to suit the particular problem. Long spacing of expansion joints offers fewer joints to give trouble and affords more elaborate precautions per joint within a given cost. Such construction is here briefly reported as applied to date.

In 1939 Kansas constructed two experimental concrete pavements, using extremely long spacing of expansion joints. These pavements were built on highly expansive subgrades in Anderson and Russell Counties. Each experimental section lies adjacent to standard construction built at the same time and differs from this standard only in spacing and detail of joints and in weight of mesh reinforcing.

Expansion joint spacing was based on the occurrence of "blow-ups" as observed in pavements built with similar aggregates and which had been constructed with little or no provision for expansion. Spacing of intermediate contraction joints was determined from data furnished by a crack survey over certain pavements in the state. Pavement salbs are 20 ft. wide and 9 in.-7 in.-9 in. thick, using mesh and joint spacing as specified below.

Construction on the Anderson County pavement was begun late in August by Harrison Engineering and Construction Co. of Kansas City, Mo., and the project was completed about the middle of December, 1939. This experimental section is three miles long and lies partly in two projects: FA 113 B (3) and FA 78 A (3) on highway U.S. 59 north of Welda.

The contract called for coarse and fine aggregates, 56 lb. mesh, expansion joints at 503 ft. 6 in., and contraction joints at 50 ft. 4 in. to 50 ft. 5 in. Expansion joints were 1¼ in. wide, filled with premoulded joint filler and sealed with 2 in. of poured rubber joint compound. No load transfer was used, but the pavement was thickened to 9 in. for a distance of 5 ft. back from the end of slab. Ten feet of crushed stone blanket with pipe under-drain were constructed beneath each expansion joint to prevent subgrade volume change due to entrapped moisture. Contraction joints were of the grooved dummy type sealed with poured rubber and with ¾ in. dowels at 1 ft. 2 in. centers for load transfer.

The Russell County section on Project FA 301 F (1) is four miles long, located on U.S. 40 west of Russell. Construction was begun early in October and completed early in November by A. L. Cook, Contractor of Ottawa, Kan. This contract called for mixed aggregates and 42 lb. mesh reinforcing. Expansion joint details were identical with the Anderson County project but the spacing was decreased to 353 ft. 9 in. Contraction joints were spaced 25 ft. 3 in. to 25 ft. 4½ in., and used continuous plate type load transfer in conjunction with a vertical separator plate.

These pavements have not been in service long enough to furnish much data. but no high joints have developed as yet and no tendency toward "blow ups" or inside corner breaks is manifest.

RATIO OF MOTOR VEHICLES TO POPULATION

According to *Automotive World News*, a publication of the U. S. Bureau of Foreign and Domestic Commerce, the latest motor vehicle registration figures (45,422,411 units in us on Jan. 1, 1940) show a per capita ownership of 1 automobile for every 47 persons in the world, as compared with a ratio of 1 to 54 ten years ago (35,805,632 units on Jan. 1, 1931). In continental United States, there is one automobile for every 4 persons, while on Jan. 1, 1931, the ratio was 1 to 4.6. Outside the United States and territories, the ratio is now 1 to 139 persons compared with 1 to every 200 persons ten years ago. The most densely motorized regions outside continental United States are Hawaii and New Zealand with 1 car for every 6 persons. Canada and New Zealand rank next, each having 1 car for every 8 persons.

EDITORIAL

SOCIAL EFFECT OF THE TURNPIKE

SOON the Pennsylvania Turnpike will be in operation. Of necessity it must be a commercial enterprise. What effects it will have upon the area it traverses can be only a matter of conjecture at this time. If it follows the trend of effects caused by state highways which are improved to a higher standard than previously existed, it is entirely probable that small towns will spring up along its route. When continued to tidewater it is not improbable that large manufacturing industries will be established near the right-of-way. Quite certainly, as its existence becomes more widely known, it will become an objective of tourist travel. How it will affect the business of the towns along U. S. 30 will be interesting to observe.

PUBLIC HIGHWAY CONCEPT

NOT all metals are iron; similarly, not all public service enterprises are public utilities. Dr. Roy W. Crum in Highway Research Abstracts discussed this point and he hit the nail on the head when he concluded with the question, "Why not envision a Public Highway Concept?"

And that is just what we should do.

He has the following to say:

"While the highways might be and have been called public utilities in the more general sense of public service enterprises, and although they have determinable costs and generate revenue and granting that the relation of those to each other should be thoroughly understood, they differ from the conception of public utilities in many important respects. In particular, they have not been developed as profit making services, the money for capital investment as well as for operations is furnished by the beneficiaries of the service, and certain items such as investment return (interest) and taxes, which enter into utility costs for rate making purposes, do not so affect tax rates for highway benefits."

There we have the characteristics which distinguish the public highway concept from the public utility concept.

A Contributed Editorial

REDUCING RESEARCH TO PRACTICAL PLANES

QUITE frequently very valuable formulae, materials, or apparatus are developed and then allowed to die a natural death for want of practical application. For instance: Henrich Hertz discovered the principle of the electro-magnetic wave in the early eighteen hundreds, and it remained a plaything of the scientists for the want of a practical application for a century—until Marconi applied it practically. Now it has revolutionized our entire social and economic structure.

It may seem like jumping from the sublime to the ridiculous when you attempt to draw a comparison between this and that common substance called soils, in common parlance dirt; but what applies to the electromagnetic wave applies to this equally as well. We have not been wrestling with this problem very long in the highway field, but in the short time it has received proper attention, emphasis has been lent toward practical application of theory to practice. Starting in the laboratory some ten or twelve years ago, practically as an unkown as far as the highway engineering profession was concerned, it is now receiving recognition because results are being obtained from the application of a few simple principles in the treatment and handling of soils.

Take one instance. At the offset everyone was talking about sand-clay mixtures and trying to determine what made them click. They kept on trying until Hogentogler and Willis brought out their soil gradation curve, then it was only a matter of time until real impetus got into full swing and we started going places, but the technique of the laboratory was entirely too long drawn out and required too much time in the preparation and testing of materials of this type. Short cuts had to be and were effected, which proved comparatively easy with the theoretical background as a check on the accuracy of the new short cut methods developed.

Field control, a basic point in the whole development, required attention. This was accomplished, again with the theoretical background as a check. Now in the designing and controlling of mixtures it is a matter of hours and no longer days.

Application of research is the crying need. You are going to make bulls, certainly you are; but who in hades built a perfect machine at the first crack out of the box without any bugs in it? Ask any equipment producer or designer and see what he tells you. Your practical application of a procedure or theory if you please, will fall in the same category but for Pete's sake don't lay down after the first try and say it can't be done. Look for the bugs and get rid of them. The late Sam Vauclain once said: "It's a damn poor man who doesn't make mistakes, but it's a damn good man who doesn't make the same mistake the second time." A well-known utility man when asked how he arrived at his decisions on various equipment, designs and procedures replied: "If it's complicated there's something the matter with it." Good philosophies both, why not realize on them. The man in the field knows that $2 + 2 = 4$ and that is all he has time for. Complicated mathematical formulae, devices and procedures must be boiled down to just that to mean anything to him, but don't forget that when you do, you have made a friend.

Above all, adopt new processings and procedures to available equipment or apparatus if at all possible and bring your new equipment along as you remove the bugs.

G. A. RAHN
Research Engineer
Pennsylvania Department of Highways

Concrete

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CRUSH ROCK GRAVEL

Don't dig and pile or haul them. That takes time and costs money. Crush and put them right back in the road bed where they belong!

These DIAMOND crushers with tractor take-off power are always on the job. Even crushing those scattered rocks while you travel down the road. No lost time.

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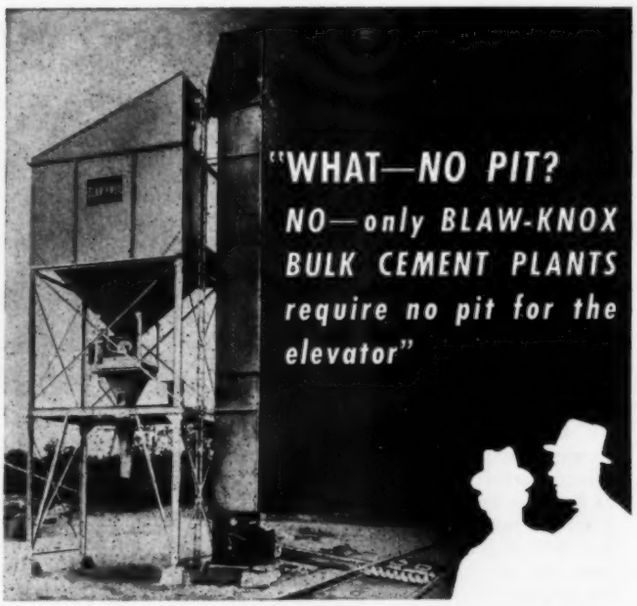
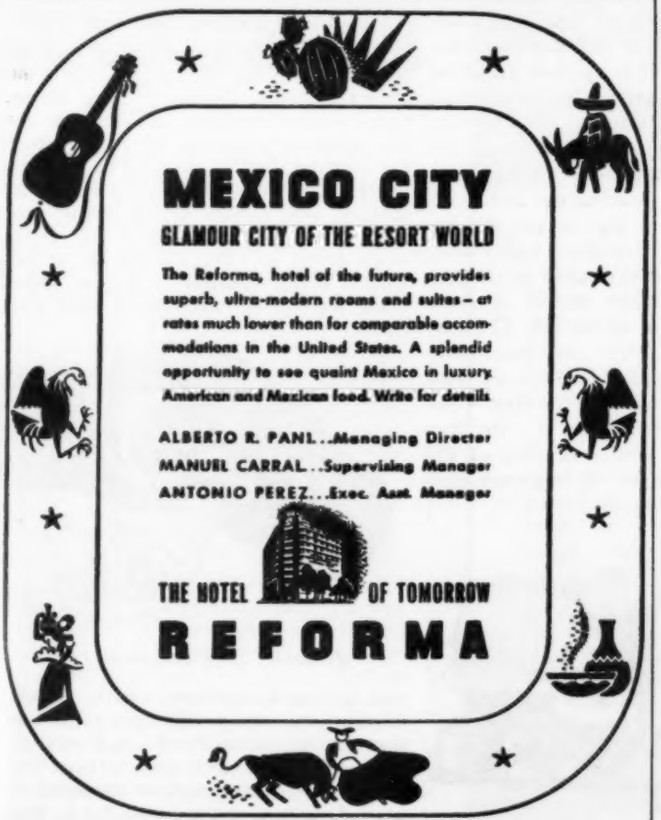
DIAMOND IRON WORKS INC.
AND THE MAHR MANUFACTURING CO. DIVISION
MINNEAPOLIS, MINNESOTA, U. S. A.



Blaw-Knox BULK CEMENT PLANTS are the ultimate in portability, speed, and convenience of use and operation. They are *complete units* for unloading, storage, batching and handling of bulk cement—dependable and accurate.

21 Completely described in Blaw-Knox Catalog No. 1566. Send for copy.

BLAW-KNOX BLAW-KNOX DIVISION OF BLAW-KNOX CO. Farmers Bank Bldg. Pittsburgh, Pa.
Bulk Cement Plants



You can lay—
1,000 to 1,200
tons per day

HOT OR COLD MIX

Moving under its own power and pushing the material truck ahead of it, this machine lays and finishes to grade, without the use of forms.

D-K SPREADER AND FINISHING MACHINE

It's Power Driven

Truck load after truck load, mile after mile, you'll save and profit by it's "one operation" advantage. It lays a smooth level surface regardless of irregularities in the old surface—no scarifying, no filling of holes or ruts.

Width and depth of spread is accurately controlled—you get straight clean edges.

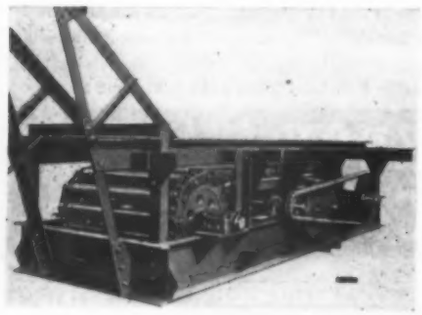
Its cost is frequently saved on one job—write for all the facts, costs and operation data.

SHUNK MFG. COMPANY
Bucyrus, Ohio, U. S. A.

NEW EQUIPMENT AND MATERIALS

New Traveling Grizzly Feeder

A new traveling grizzly feeder, designed to feed a steady stream to the primary crusher, to handle the large rocks without delay and to by-pass the dirt and small materials around the crusher, has been added to the line of the Pioneer Engineering Works, Inc., 1515 Central Ave., Minneapolis, Minn. The feeder is stated to take long rocks and feed them end first into the crusher opening and eliminate choking and prevent bridging. A clutch, with controls on the operator's platform, permits accurate control of the feed. If a rock is too large for the crusher, the feeder is stopped, the rock broken by sledge, and the feeder started with no delay to the crusher. If there is an excess of dirt in the rock, a screen can be located below the feeder, the dirt rejected, and the rock delivered onto the conveyor with the product from the primary crusher.



New Pioneer Traveling Grizzly Feeder

New Truck

A new truck model, the LM, designed expressly for heavy hauling over the highway, has been announced by Mack Trucks, Inc., Long Island City, N. Y. The new model LM is offered in two standard wheelbase lengths of 176 in. and 194 in., respectively. Special wheelbase lengths of 212 in. and 230 in. are available at the customer's wish at extra charge. Standard equipment on the LM includes, among other items, double-acting hydraulic shock absorbers on front and airbrakes. The LM is powered by the six-cylinder model EO Mack Thermodyne engine with 4⅜ in. x 5¼ in. bore and stroke developing 142 h.p. at governed speed of 2200 r.p.m. Total piston displacement of this engine is 519 cu. in. and it has a compression ratio of 5.4 to 1. Torque developed is 378 lb.-ft. at 1000 r.p.m. In addition to this Mack EO engine which is standard in the LM, Mack is also offering, at extra charge, the larger model EP Mack Thermodyne engine of 611 cu. in. piston displacement, an engine which develops 160 h.p. at governed speed of 2100 r.p.m. Both engines are of similar design their crankshafts having seven main bearings, being fully counterbalanced on every throw, and of drop-forged, case-hardened, low carbon steel. Cylinders are chrome-nickel alloy semi-steel heat-treated and are cast in block with two detachable

New Mack Model LM

heads held down by 40 studs. The crankshafts have a Lanchester-type vibration damper. They are 3½ in. in diameter and weigh 182 lb. For those desiring Diesel power, Mack offers for installation in the new model LM the Model ED Mack-Lanova Diesel engine of 519 cu. in. piston displacement.

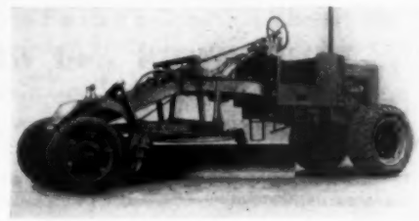
New Moto-Mixers and Agitators

A complete new line of Rex moto-mixers and moto-agitators, featuring larger drum volumes and drum diameters and shorter overall lengths, and designed specifically to make the most of the increased carrying capacity of modern high speed trucks, has been brought out by the Chain Belt Co., 1609 West Bruce St., Milwaukee, Wis. Among the new features of the new Rex motor-mixer is the new no-leak Rex discharge door which is definitely leak-proof, maintaining true alignment with the drum at all times. It is operated from the mixer or from the ground by a non-creeping hand-wheel. Eliminating the need for stopping the drum to change gears, the new Rex moto-mixers offer the Rex twin clutch transmission wherein one lever controls all speeds from high to low and in-between. Optional, at slighter higher cost, are the Rex pneumatic controls which give the driver finger-touch control of drive speeds from his seat in the cab. The new sizes are the Rex 2 yd. moto-mixer with a capacity of 104 cu. ft.; the 2½ yd. with a capacity of 156 cu. ft.; the Rex 4 yd. with a capacity of 208 cu. ft.; the Rex 5 yd. moto-mixer with a capacity of 250 cu. ft.; and the Rex "Metropolitan Special" with a capacity of 270 cu. ft.

New Rex Moto-Mixer

New Grader

A new light weight power grader designed especially for maintenance work in counties, townships, cities and villages has been added to the line of the Galion Iron Works & Mfg. Co., Galion, O. An International Model IU 4, four-cylinder, 31 HP gasoline engine mounted over rear axle supplies the power, which is transmitted to axle by means of a multiple-V belt drive.

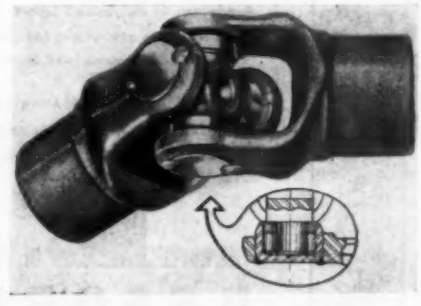


Galion No. 401 Motor Grader

All controls, with exception of the moldboard sideshift, are located in the cab, directly in front of operator. Raising and lowering the moldboard, also scarifier attachment or snow plow when so equipped, is by hydraulic control, providing quick and easy adjustment. Steering is by automotive type steering wheel through Ross cam and lever heavy duty type steering gear conventionally mounted. The dimensions of the grader are: Length over-all, 17 ft. 8 in.; width overall, with 36x6 dual tires, 71 in.; wheelbase, 14 ft. 4 in. The turning radius is 26 ft. The speeds are as follows: 1st gear, 1.81 miles per hour; 2nd gear, 2.95; 3rd gear, 4.24; 4th, 5.97; 5th, 12.60 and reverse 2.43. The standard blade is 8 ft. x 18½ in. x ½ in. and the base is 68 in.

New Roller Bearing Universal Joint

A new roller bearing universal joint has been added to the line of the Merchants Universal Joint Division, Borg-Warner Corporation, Rockford, Ill. This new unit was designed primarily for tractor steering columns, but it can also be used for many other drives such as road grader controls and various drives within farm implements, such as snapping roll drives, sickle drives, etc. This joint is 5½ in. long with a swing diameter of 2¼ in. and is made entirely of heat treated steel forg-

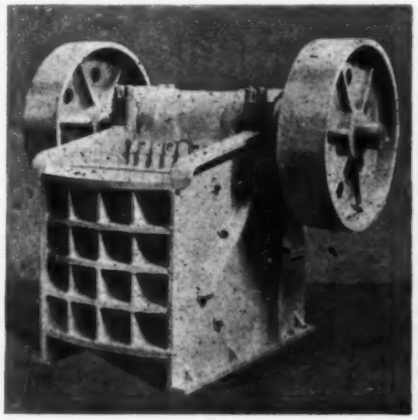


Mechanics 1CA Universal Joint

ings accurately machined and is of roller bearing construction with four roller bearings running on hardened and ground surfaces and fitted with cork grease seals, which also operate against hardened and ground surfaces and are protected by being completely enclosed.

New Jaw Crusher

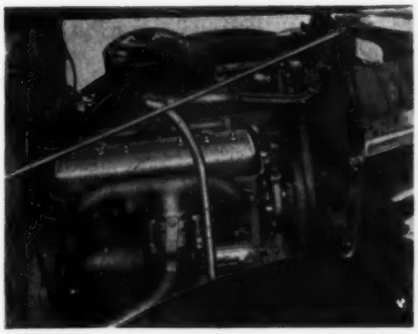
Two new jaw crushers have been announced by the Diamond Iron Works, Inc., Minneapolis, Minn. Made in sizes 20x36 and 24x36, these two models have many features embodying the latest in crusher development. The main frame is all welded from heavy steel plate, annealed for stress relief and accurately machined. The eccentric pitman shafts designed for heavy duty have liberal oversize dimensions. These shafts are forged from special alloy steel to rough dimensions, machined, heat treated, ground and polished to accuracy for bearing fits. Journal and pitman bearings are all special purpose heavy duty roller types with rating for shock loads far in excess of hard rock crushing factors. Pitman is of heavily ribbed steel castings, annealed and accurately machined for bearings, toggle seat and manganese jaw. Jaws, check plates and pitman toggle seat are of manganese steel castings. Product size adjustments are by reversible hand lever ratchet raising or lowering the adjusting wedge against the rear toggle seat. Adjusting mechanism is enclosed for dust and dirt protection. The cast iron toggle has chilled bearing edges. This toggle is designed to break, if large pieces of tramp iron or other uncrushable materials jam the jaws, thereby protecting the expensive parts of the crusher. Lubrication is by Alemite high pressure fittings to each individual bearing which is sealed against dirt and abrasive grit. All bearings are equipped with flush and drain openings for cleaning old grease from bearings when advisable.



New Diamond Jaw Crusher

New Diesel Replacement Engine

A "Power Package" diesel replacement engine for Chevrolet trucks has been added to the line of the Hercules Motors Corporation, Canton, O. It was announced that the unit has been completely engineered for the 1940 conventional model Chevrolet truck and that a replacement diesel for the 1940 cab-over-engine model will shortly be available. Late in 1938 Hercules developed a "Power Package" replacement unit for Ford Trucks, marketing the engine through a nation-wide distribution set-up. Hercules Diesel engines for Chevrolet Trucks will be sold and serviced through the same type of outlets. The basic engine design from which the Chevrolet "Power Package" unit has been developed is the well-known Hercules Model DOOD Diesel. Installation of the Hercules diesel engine in the Chevrolet truck chassis is quickly accomplished by any good mechanic with one helper. No major changes in the chassis are necessary. The engine is started with the same button used for starting the gasoline engine regularly furnished in Chevrolet trucks. Speed is controlled by foot accelerator and the engine is stopped by a slight pull on a conveniently placed handle on the dash.



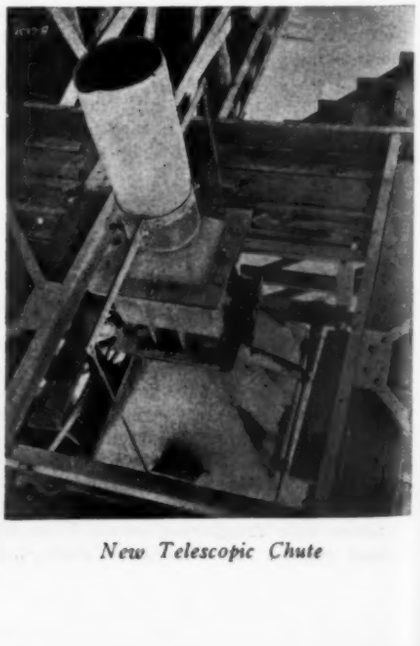
Hercules Diesel Unit for Chevrolet Trucks

New Line of Roll Crushers

The Iowa Manufacturing Co., Cedar Rapids, Ia., has redesigned its entire line of roll crushers, incorporating several new mechanical and structural features. In the new Cedarapids crushers, the roll shells are mounted on tapered cores by means of three sectional wedges. The shell is tapered to correspond so that when bolts are tightened the tension is exactly the same all around the shell and it is held firmly without slipping. Smoother operation, longer wear and lower power consumption are claimed to be assured in all sizes of Cedarapids roll crushers by the use of pinion and gear drives from countershaft to stationary shaft and by use of finger timing gears for transmission of power from the stationary to the floating roll. Both the gear and pinion and the finger gears are completely enclosed and run in oil. Adjustment of the opening between rolls can be made very simply and quickly by removing or inserting shims in a slot on top of the frame. These adjustments can be made while the roll is operating. Heavy helical chrome vanadium steel wire springs keep the proper tension on the floating roll so that the opening between rolls remains constant under proper working conditions. The springs relieve undue stress and prevent breakage if uncrushable material is accidentally introduced. If the uncrushable material should be exceptionally large, shear plates at the ends of the springs relieve the tension entirely. All sizes of Cedarapids crushers are equipped with antifriction bearings. Seals completely confine the lubricant and prevent the entrance of foreign matter to the bearings. The entire countershaft and bearing assembly is completely enclosed in a tubular steel housing. Bearings are placed far out on the shaft; one bearing near the hub of the flywheel and the other bearing near the pinion. The frame is welded, riveted and cross-braced I-beam construction — roll shells are manganese steel—the flywheel is extra heavy semi-steel—countershaft bearings are Timken tapered roller and roll shaft bearings are SKF cylindrical roller. Six sizes are built: 16 in. x 16 in., 24 in. x 16 in., 30 in. x 18 in., 30 in. x 22 in., 40 in. x 20 in. and 40 in. x 24 in.

New Chute for Cement Weighing Batchers

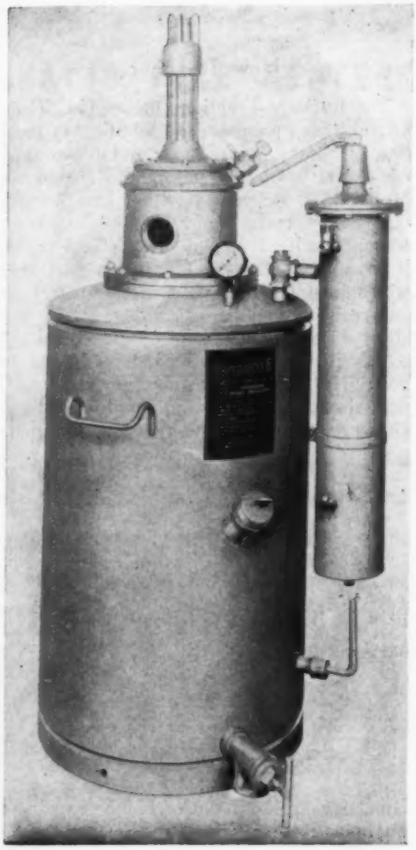
A new telescopic chute for use on bulk cement weighing batchers to accommodate various sizes and heights of batch trucks and truck mixers has been developed by Blaw-Knox Co., Farmers Bank Bldg., Pittsburgh, Pa. A number of these have been furnished for use on the Pennsylvania Turnpike and other projects where batching plants are called upon to serve a wide variety of trucks. Batching operations are facilitated because the chute compensates for varying heights with a minimum loss of time. Ease of adjustment is assured by a counterweighted construction. The amount of vertical adjustment ranges between 31 and 50 in. This provision to accommodate differences in height enables complete elimination of cement spillage during discharge. The new chute illustrated in the accompanying photo can be furnished for standard manual cement batchers, or for the shrouded type of batcher required in some states. It can be installed satisfactorily on any Blaw-Knox cement batcher of the rotary discharge valve type.



New Telescopic Chute

New Portable Acetylene Generators

Four new portable acetylene generators have been placed on the market by the Marquette Manufacturing Co., Minneapolis, Minn. Marquette portable acetylene generator No. 512 has a 12 lb. carbide capacity, 12 gal. water capacity, stands 40 in. high, weighs 95 lb. and produces 24 cu. ft. per hour. Number 515 holds 15 lb. of carbide, 17 gal. of water, is 50 in. high, weighs 96 lb. and delivers a maximum of 30 cu. ft. per hour. Number 530 has a capacity of 30 lb. of carbide and 33 gal. of water, is 61 in. high, weighs 123 llb. and produces 60 cu. ft. per hour. Number 550 is the largest size, holding 50 lb. of carbide, 55 gal. of water, stands 69 in. high, weighs 177 lb. and delivers up to 100 cu. ft. of acetylene gas an hour.



New Marquette Portable Acetylene Generator

New Whiteprint Machine

A new medium priced, fast-printing whiteprint machine has been added to the line of the Ozalid Corporation, Ansco Road, Johnson City, N. Y. Featuring a newly developed high pressure mercury vapor tube which uses 40 watts per inch and provides uniform distribution of light over the entire printing area, this machine will print up to 56 in. per minute. The tube is guaranteed for 1,000 hours, but has an expected life of 1,500 to 2,500 hours. The original and sensitized materials are brought into exposure by carrier belts, which hold them against a 4¼-in. diameter pyrex glass cylinder. This cylinder is suspended at each end on three ball bearing rollers and is revolved around the stationary high pressure mercury vapor tube by contact with the carrier belts. The glass cylinder, tracing and sensitized material revolve at the same rate of speed and thus there is no slippage to cause distorted prints. The operator selects the desired printing speed with a hand control knob conveniently located on the front of the machine. An adjustable light shade allows the operator to vary exposure within certain limits without changing the printing speed. Mechanically controlled ammonia vapors develop the exposed prints in the developer section of this machine. A rubber belt carries the print over the perforated top of the developing tank and at the same time acts as a seal, keeping the ammonia vapors within the tank.

Ozalid Model F Whiteprint Machine

New Traffic Line Marker

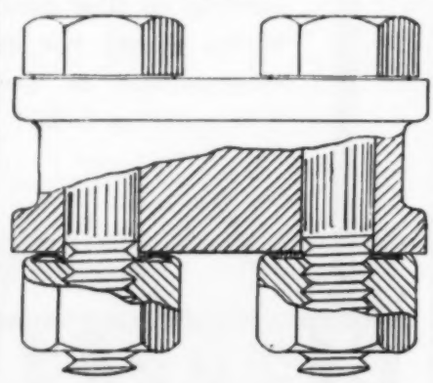
A new marker developed by the Meili-Blumberg Corporation, New Holstein, Wis., is stated to automatically apply single, double or triple center lines or road lanes, solid or intermittent, in one, two or three color combinations. Either paint or hot asphalt may be used. The marking unit is mounted on a three-wheeled chassis which may be attached to the rear axle or running board of the towing vehicle. If desired, the unit can also be pushed ahead of the truck

New M-B Traffic Line Marker

so as to provide an unobstructed view for the operator. To attain greater accuracy and speed, an adjustable, detachable guide is furnished. Also, should the driver of the towing vehicle deviate from his course, the marking unit operator can at will steer the unit itself to any prescribed course or shift it from side to side. The entire operating mechanism is easily controlled by three centrally located levers. Length of intermittent marks may be predetermined and the machine adjusted to produce the desired length of line, either automatically or by manual control at the operator's discretion. Clean cut lines are assured by the use of internal atomizing type spray guns and floating side shields. Provision is made to clean the road surface ahead of the spray guns by blowing away the dust before the paint is applied.

New Lock Nut

A new self-contained, one piece, all metal lock nut just announced by the An-cor-lox Division of Laminated Shim Co., Inc., 64 Union St., Glenbrook, Conn., utilizes a new locking principle that permits effective, positive, locking of the nut to the bolt, not to the work. To apply, lock nut is simply spun on the bolt and drawn up to the desired degree of tightness. The nut locks itself automatically to the bolt. The accurate shaped metal locking ring contained in the bottom of the nut is expanded by the locking pressure into the root of the bolt thread and against the nut rim. This "lock joint" is stated to hold securely under all heat conditions and vibration. No special length of bolt is required. The lock nut does not damage the bolt thread or mar the surface of the work, and the same nut can be used time and time again without loss of locking effectiveness.



The An-cor-lox Lock Nut in Locking Position and Locked

New Trencher

The Buckeye Traction Ditcher Co., Findlay, O., has announced an addition to their line of rotary wheel type and boom type trenchers. A wheel type and designated the Model 12A, the new trencher incorporates many new features in a single, rugged, compact unit. The excavator wheel frame is of a new "trussed bridge" construction which is stated to provide greater strength and resistance to distortion than former designs of equal weight. A "fluid coupling," which is optional equipment, is stated to positively protect transmissions from sudden shocks and prevents engine stalling. Conveyor belt has new type of belt guide

Model 12A Buckeye Trencher

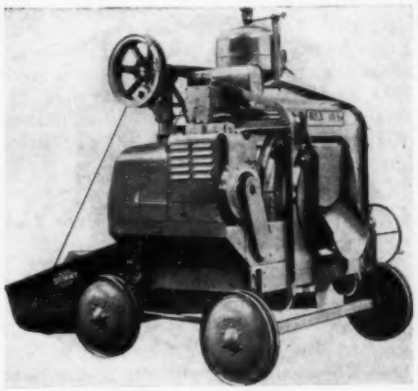
clips, developed by Buckeye. The excavator final drive is the Buckeye constant center type. The new Model 12A cuts trench up to 26 in. wide and up to 5 ft. 6 in. deep. Overall width (exclusive of spoil conveyor) is only 6 ft. 8 in.; overall digging height is 8 ft. 1¼ in. A wide range of cutting feeds, conveyor belt speeds and travel speeds are provided for all types of work.

Haynes Stellite Builds Plant Addition

Haynes Stellite Co., Unit of Union Carbide and Carbon Corporation, is expanding its manufacturing facilities at its plant in Kokomo, Ind., by the addition of a new 75 x 132-ft. factory building, a 1-story structure of steel and brick with concrete floor and wide monitor top. Construction was started May 27 and it is expected that the building will be ready for use in August. Some of the features of the building are: continuous steel sash for efficient lighting; large ventilating fans for rapid air change; gypsum roof; modern toilet, locker, and shower facilities. The new building will house machinery to be used in the manufacture of Haynes Stellite alloy products: metal-cutting tools, hard-facing rods, and special castings for resisting abrasion, corrosion, and heat.

New 10-S Mixer

A new Rex 10-S mixer has been brought out by the Chain Belt Co., 1609 West Bruce St., Milwaukee, Wis. This new Rex mixer is being produced with an air-cooled motor which has already been so successfully used on Rex 5-S and 7-S mixers. Besides the new power, the new Rex 10-S mixer incorporates all the exclusive features which have been found on Rex machines for many years. These features include Rex shimmy skip, Rex outside pivoted 7 second discharge, Rex modern drum, Rex positive water system and free-way valve, Rex Timken drum rollers, Rex chain drive and Rex fully enclosed transmission countershaft.



New Rex 10-S Mixer

WITH THE MANUFACTURERS

L. D. Cosart Appointed Sales Manager Dodge Truck Division

L. D. Cosart

Lee D. Cosart has been appointed sales manager of the truck division, Dodge Brothers Corporation. In taking the helm of truck sales manager, Mr. Cosart returns to the Dodge fold. His first connection with the automobile business was with Dodge in Chicago in 1926, and he remained with Dodge continuously in executive sales capacities in the field and at the factory until his appointment as Plymouth assistant sales manager 2½ years ago and later as Plymouth's general sales manager. In addition to sales work at the Dodge and Plymouth home offices, Mr. Cosart's experience includes the direction of Dodge district and regional sales organizations in Washington, Greensboro, Atlanta, Columbus, Cincinnati, St. Louis and Chicago. Mr. Cosart's appointment fills a vacancy created by the resignation recently of T. W. Moss, formerly director of Dodge truck sales.

Death of Harry T. Smith

Mr. Harry T. Smith, Traffic Manager of Worthington Pump and Machinery Corporation, died at his home on July 3, 1940. Mr. Smith was associated with Worthington for 54 years, having started with the old Henry R. Worthington Hydraulic Works, then located in Brooklyn. Mr. Smith was a native of Brooklyn, and was educated in its Public Schools and at Pratt Institute. At the time of his death, he was a resident of Metuchen, N. J., and his Worthington headquarters have been, since 1933, at Harrison, N. J. Popular with his associates, and admired for his ability, his passing is a great loss to all who knew him.

R. T. Sherrod Transferred to New York for Chain Belt

Chain Belt Co., Milwaukee, Wis., has announced the transfer of R. T. Sherrod, previously located at the Milwaukee home office as Pumpcrete sales engineer, to New York City, where he will act in the same capacity for the Metropolitan area. Mr. Sherrod is a civil engineering graduate of Texas University and recently worked for the Chicago Sanitary District. He has been with the company for the past 3 years in both engineering and sales capacity.

T. R. Lippard Elected President Federal Truck

T. R. Lippard has been elected president and general manager, as well as a director of the Federal Motor Truck Co. He succeeds R. W. Ruddon, resigned. Mr. Lippard joined the Federal organization last fall as vice-president in charge of sales and engineering. He has been identified with the motor truck industry for more than 28 years, and for a number of years was president of the Stewart Motor Corporation of Buffalo, N. Y.

H. A. Taylor Joins New York Office Truscon Steel

H. A. (Toby) Taylor, for 14 years New York District Manager for the Concrete Steel Co., has joined the New York district office of Truscon Steel Co., where he will be in charge of the sale of reinforcing bars, steel joists and kindred products.

Trailmobile Personnel Change

Personnel changes announced by A. J. Woltering, Executive Vice-President, and L. E. Craig, General Sales Manager of Trailmobile at Cincinnati, O., included the appointment of William R. Cubbins, Jr., as Eastern Zone Manager with offices in New York City. Formerly with Bendix in Fleet Sales, "Bob" Cubbins is well known to operators and dealers in the eastern part of the United States. R. B. George for the past several years New York sales manager for Trailmobile has been placed in charge of fleet sales for the company. Leo A. Santry has been appointed New York Branch Manager of Trailmobile with offices at Long Island City. For the past 5 years in the Fleet Sales division of Bendix, operating on the eastern seaboard with headquarters in New York, Mr. Santry is well acquainted with all highway transport problems in that territory.

G. G. Bobst Named G-E Lighting Specialist

Glenn G. Bobst, formerly with the lighting sales section of the General Electric Lighting Division at Schenectady, N. Y., has been made a lighting specialist for the company with headquarters in Syracuse, N. Y. Mr. Bobst for the past four years has been engaged in the sales and promotion of such lines as street and traffic signal lighting, and floodlighting. Employed by the G-E testing department in April, 1934, after graduation from Union College in 1932 with a B.S. degree in electrical engineering, Mr. Bobst transferred to the lighting division in 1936. In his new job, Mr. Bobst will cover the territory east from Syracuse as far as Albany, north to the Canadian border, and south to Binghamton, N. Y.

Sumner Pond Made Manager Detroit Office Universal Gear

Sumner Pond has been appointed manager of the Detroit office of the Universal Gear Corporation, Indianapolis, Ind. Mr. Pond has been associated with the factory sales department for two years. He will be in full charge of sales for Detroit area with offices at 2842 West Grand Blvd., 412 Curtis Bldg., Detroit, Mich.